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Barriers and facilitators to scaling up a preconception-to-early childhood health intervention in rural India: A convergent mixed-methods formative study in Himachal Pradesh

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Research Article

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Title: Barriers and facilitators to scaling up a preconception-to-early childhood health intervention in rural India: A convergent mixed-methods formative study in Himachal Pradesh

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Abstract

Background: Maternal and child undernutrition remain persistent public health challenges in India despite large-scale nutrition programmes. The WINGS randomized controlled trial demonstrated that a multi-domain intervention delivered from preconception through early childhood improved birth outcomes and maternal health under trial conditions. Translating this efficacious package into routine public health and nutrition systems requires contextual adaptation. This formative study assessed systems readiness and barriers and facilitators to scaling up the WINGS intervention in Amb block, Una district, Himachal Pradesh.

Methods: A convergent parallel mixed-methods design was used. Quantitative data comprised three rounds of cross-sectional household surveys and facility assessments in the learning block, which were analysed descriptively. Qualitative data included in-depth interviews, focus group discussions and non-formal interviews, analysed using hybrid inductive-deductive thematic analysis and mapped to the Consolidated Framework for Implementation Research (CFIR). Quantitative and qualitative findings were integrated during interpretation through triangulation and joint display matrices.

Results: Preconception care was neither socially recognised nor institutionally operationalised: 84.3% of preconception women took no nutritional supplements, no structured preconception services existed at any facility level; a double burden of obesity (41.8%) and anaemia (62.4%) was observed. Antenatal care showed fragmentation, with PMSMA clinics substituting for routine antenatal visits. Transportation barriers deterred access for both workers and beneficiaries. Gestational weight gain and mental health status were rarely assessed. Supplementary nutrition reached most beneficiaries (94-97% take-home ration) but varied acceptability and intra-household sharing (44.4% among children) limited effective consumption. Documentation systems were present but functionally weak, compounded by workforce vacancies.

Conclusions: While the health and ICDS systems in Una district possess substantial structural assets, functional readiness for a preconception-to-early-childhood intervention is uneven across

the continuum of care. Scale-up of WINGS will require establishing preconception care as a distinct service category, strengthening ASHA-Anganwadi Worker coordination, tailoring nutrition counselling to local dietary norms and the dual burden of malnutrition, and reinforcing documentation and referral systems. These formative findings provide a baseline against which iterative adaptation and scale-up of the WINGS intervention can be evaluated.

Trial registration: CTRI/2023/10/058538, registered on 11/10/2023.

Keywords: Preconception, India, WINGS intervention, Consolidated Framework of Implementation Research, Implementation research, Mixed-methods study

Background:

Maternal and child health remain critical priorities in India's public health agenda. The Sustainable Development Goals call for an end to preventable maternal and child deaths and the elimination of malnutrition.[1,2] Progress on child malnutrition has been slow but steady; between NFHS-5 and NFHS-6, stunting and wasting declined significantly, but underweight children only marginally lessened from 32.1% to 31.8%.[3,4] Maternal undernutrition follows similar patterns; anaemia affects over half of pregnant women in India, and low maternal BMI and short stature are well-established risk factors for adverse birth outcomes.[5,6] Despite large-scale programmes- including the Integrated Child Development Services scheme, the public distribution system, and the mid-day meal scheme- persistence of this dual burden reflects the inadequacy of siloed, post-pregnancy interventions alone.[7,8,9]

The Developmental Origins of Health and Disease (DOHAD) framework emphasized the influence of maternal health status before conception on neonatal and later-life outcomes.[10] The window before pregnancy is critical for interventions to improve maternal, newborn, and child health.[11] Therefore, the continuum of care for maternal and child nutrition must extend from before conception to after birth of the child. Periconception iron-folic acid supplementation, optimisation of inter-pregnancy intervals, and nutrition interventions have demonstrated effectiveness in improving maternal and birth outcomes.[12] Concurrently, awareness gaps, modifiable risk factors, and the need for locally adapted counselling services have also been documented across LMICs, including South Asia.[13] However, evidence on translating these interventions from controlled trial settings into routine health systems remains limited, with poorly characterised delivery mechanisms, particularly for social and behavioural components.[14]

The WINGS randomized controlled trial evaluated the efficacy of multi-domain interventions spanning health, nutrition, psychosocial support, and water, sanitation, and hygiene (WaSH), delivered across the preconception, pregnancy, and early childhood (0-24 months) periods.[15] The trial demonstrated significant benefits in the preconception intervention group- reduced

incidence of low birth weight and small-for-gestational-age births, higher mean birth weights and maternal haemoglobin, and fewer reproductive tract infections- establishing the package's efficacy under controlled conditions.

While WINGS demonstrated efficacy in an urban trial setting, its translation into routine district health systems requires contextual adaptation. Trial interventions delivered by study teams are resource-intensive, underscoring the need to examine their effective implementation and sustainability in real-world settings. Many rural women in India do not access antenatal care until the second trimester due to socio-cultural barriers, underscoring the critical need for preconception interventions.[16]

Acknowledging the criticality of scaling up the WINGS intervention with real life contextual realities, a national dissemination meeting was conducted at the ICMR headquarters conducted by ICMR, NITI Aayog and BIRAC. All states participated and Himachal Pradesh was the first state to take on the implementation research to scale-up WINGS integrated interventions, across four domains- health, nutrition, psychosocial care and WaSH- to be delivered concurrently to four groups of beneficiaries: preconception, pregnant and postnatal women, and children from birth to 2 years of age.

Against this background, this formative research aimed to assess health-systems readiness, beneficiary and provider perspectives, and contextual barriers and facilitators influencing the adaptation and scale-up of the WINGS preconception-to-early-childhood intervention within routine health and ICDS systems in Amb block, Una district.

The specific objectives are to:

1. Assess the readiness of the health and ICDS systems in Amb block, Una district, to deliver a preconception-to-early-childhood intervention across the continuum of maternal and child health care.
2. Identify barriers and facilitators to the implementation of the WINGS scale-up intervention at the individual, community, and health system levels.

3. Generate evidence to inform contextual adaptation of the WINGS intervention for routine health system delivery in Una district.

Methods

The formative phase of the study was conducted from March to December 2025, in Amb, one of the 5 blocks in district Una in Himachal Pradesh. Una, being an average performing district, with a mix of urban and rural populations and with most of the health and ICDS systems in place and functional, was selected at the outset by the government stakeholders. Una has a population of 5,21,173, with 91.38% of the population residing in rural areas.[17]

A convergent parallel mixed-methods design was used to estimate health-systems readiness and contextual determinants influencing WINGS scale-up implementation. Quantitative methods were used to estimate systems readiness and service utilisation, while qualitative methods explored behavioural, social, and systemic factors influencing intervention delivery and uptake. Quantitative and qualitative data were collected concurrently, analysed independently, and integrated during interpretation using triangulation and joint display matrices. Areas of convergence, complementarity, and discordance across datasets were subsequently mapped to the Consolidated Framework for Implementation Research (CFIR) to identify priority barriers, facilitators, and adaptation needs for scale-up.[18]

Ethical approval was granted by the Institutional Ethics Committee (SAS/ERC/WINGS Scale up-HP/2023). The Biotechnology Industry Research Assistance Council (BIRAC) (GCI-13012/3/2024-GCI) provides national oversight for this project. Necessary administrative approvals have also been secured from the Government of Himachal Pradesh through the State Departments of Health and Family Welfare and Women and Child Development (Memo no Shimla-2/1June/2023/8483). Written informed consent was obtained from all participants prior to data collection.

Quantitative data

Quantitative data were collected from households and service delivery facilities in the learning block (Amb). Pilot-tested structured observation and questionnaire schedules were designed for facility assessment and household surveys. Responses were recorded in standardized tools designed on SurveyCTO. This enabled real-time data entry and automated validation checks, minimizing errors and ensuring data quality.

Facility assessment: Facilities were assessed for service readiness, infrastructure, staffing, supplies and operations, and to identify systems-level gaps that may influence implementation of the planned intervention. This was done across the sampled health facilities and Anganwadi centres. As the number of civil hospitals, community health centres and primary health centres in Amb is small, all were assessed. For health and wellness centres- Ayushman Arogya Mandirs (HWC-AAM), 10 (30%) out of 31 were selected, while 72 (30%) out 248 Anganwadi Centres were chosen purposively to adequately depict variations in geography, remoteness, and population catchment size.

Household surveys: Three rounds of cross-sectional surveys were conducted in the learning block to obtain information on sociodemographic status, nutritional status among beneficiaries, current practices during preconception period, pregnancy and childhood related to health, nutrition, psychosocial support and WaSH, including care seeking and referral practices. Prevalence data of 1744 participants were pooled across the 3 survey rounds. Background characteristics of the participants are reported as pooled estimates across all three rounds, while round-wise estimates are presented descriptively to show variation across formative survey rounds; these data reflect the trend at each cross sectional time point at population level

The statistical power to detect a 20% change in the level of outcomes was estimated to be 88.3% (95%CI: 86.3 to 90.3) using the “itspower” package in Stata 17.[19] The aim is to achieve 20% change in the primary outcomes, compared to pre intervention status, a sample size of 600 women and children during each round would be the ideal and adequate. To account for potential refusals and non-responses, an expanded list of 135 beneficiaries in each category was

generated. Each round drew from a distinct sample of households; no household was revisited across rounds. In the event of refusal or non-response, replacement participants were drawn from the expanded list generated for that round. **(Figure 1)**

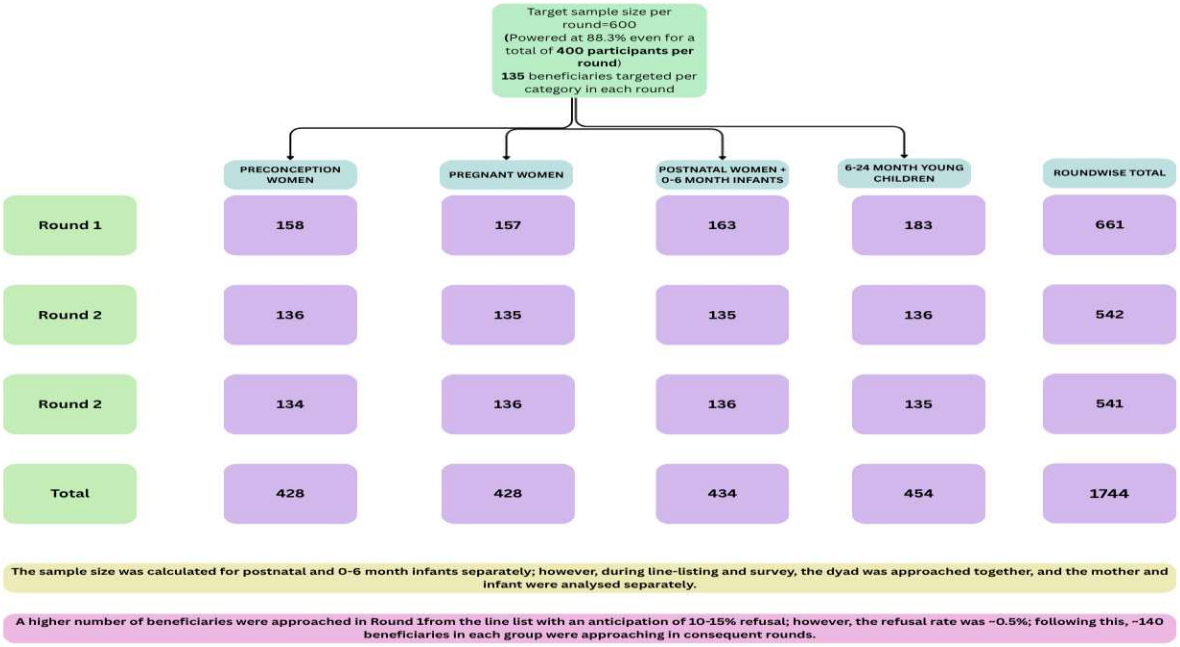


Fig 1: Sampling methodology for household survey

Both facility assessment and household survey teams underwent comprehensive, rigorous training and standardization on data collection, with discussions on appropriate conduct, respondent interaction, and probing techniques for each item. Initial theoretical training was followed by mock sessions and finally hands-on training in the field. The process of data collection was closely supervised by team coordinators. Data quality and inconsistencies were monitored and communicated immediately to the team members for course correction.

Qualitative data

The qualitative component was conducted by trained study coordinators (female medical practitioners with master's in public health) and investigators (female medical doctors with specialization in public health/PhD), all of whom had prior experience in qualitative research. No prior relationship was established between the interviewers and participants before the study, and

non-participation was not tracked. Some team members were involved in programme implementation; to minimise bias, they did not interview direct beneficiaries, and reflexive discussions examined field notes, assumptions, and programmatic experience that could influence interpretation.

Participants were selected using purposive sampling to capture diverse perspectives on preconception, maternal, and child health service delivery and utilization. They were approached by household visits, and visits to healthcare and ICDS centres. The sample included: health service staff (MOs, CHOs and ASHAs), ICDS staff (supervisors and AWWs), beneficiary subgroups (preconception, pregnant, and postnatal women, and mothers of infants and young children), community-level key informants, and senior programme and administrative officials. Non-formal interviews were conducted with members of the district implementation unit- Chief Medical Officer, Programme Officers of Maternal and Child Health, and District Programme Officer-ICDS, to understand policy, governance, and system-level considerations. Four individuals (1 ASHA, 1 medical officer, 2 beneficiaries) declined to participate, citing a lack of time to participate.

Data were collected using in-depth interview and focus group discussion guides finalized following pilot testing (**attached as supplementary file S1)**. All interviews were conducted by trained researchers in the local language, audio-recorded with consent, and supplemented with field notes made after each visit. Audio-recordings were transcribed, and field summaries were checked with selected participants where feasible. Participants were approached face-to-face, informed of the study aims and the interviewers' role. Beneficiary interviews took place in participants' homes, and provider interviews and FGDs in a private room at their facility, with no non-participants present. Sampling and data collection were iterative, continuing until thematic saturation was reached within each participant category. Qualitative analysis used a hybrid inductive-deductive thematic approach. Initial codes were generated inductively from transcripts and field notes by two coders. Disagreements were discussed within the research team and

resolved through consensus. Codes were then mapped to CFIR constructs to support interpretation of implementation barriers and facilitators. Reflexive discussions were held because some researchers were also involved in program planning.

Data analysis: Quantitative data from household surveys and facility assessments were analysed descriptively using frequencies, percentages, means with standard deviations, or medians with interquartile ranges, as appropriate. Qualitative transcripts and field notes underwent hybrid inductive-deductive thematic analysis: two experienced investigators independently coded the data, resolving disagreements through a third investigator, with initial codes inductively generated from the data and subsequently mapped onto CFIR constructs to provide theoretical grounding. Mixed-methods integration occurred during interpretation through triangulation and joint display matrices, with quantitative and qualitative findings examined for convergence, complementarity, and discordance. The joint display was used to link quantitative estimates, qualitative explanations, CFIR constructs, and specific adaptation implications for WINGS scale-up. **(Figure 2)**

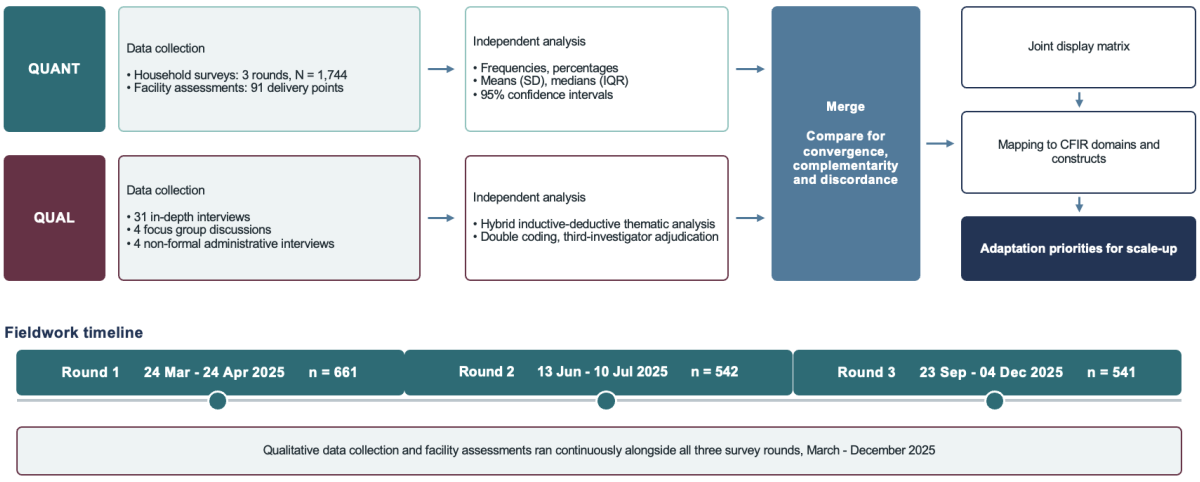


Fig 2: Depiction of the convergent parallel mixed-methods employed in analysis

Results:

Across the three formative household survey rounds, 1,744 beneficiaries were included. Facility assessments covered higher-level public facilities in the learning block, 10 HWC-AAMs, and 72 Anganwadi centres. Qualitative data included 31 in-depth interviews with beneficiaries and service providers, four focus group discussions with ASHAs and Anganwadi Workers, and four non-formal administrative interviews. **Table 1** summarises the study components.

Component	Sample/source	Selection or coverage	Main purpose
Household survey	1,744 beneficiaries across three repeated cross-sectional rounds	Line lists prepared for preconception women, pregnant women, postnatal women/infants 0-6 months, and children 6-24 months; classify by status on day of survey	Estimate service awareness, utilisation, nutrition practices, documentation, and process indicators
Facility assessment - health facilities	All higher-level public facilities in Amb block; 2 Civil Hospital, 1 CHC, 6 PHCs], and 10 of 31 HWC-AAMs	All higher-level facilities assessed; 30% HWC-AAMs selected for variation by geography, remoteness, and catchment size	Assess readiness, staffing, supplies, documentation, counselling, and referral capacity
Facility assessment - ICDS	72 of 248 Anganwadi centres	30% selected for variation by geography, remoteness, and catchment size	Assess supplementary nutrition delivery, infrastructure, equipment, growth monitoring, and referral readiness
In-depth interviews	31 interviews: health facility staff (n=5), ICDS supervisors (n=5), preconception women (n=5), pregnant women (n=5), postnatal women (n=5), key informants (n=6)	Purposive sampling for diversity of roles and perspectives	Understand barriers, facilitators, norms, and implementation feasibility
Focus group discussions	4 FGDs: ASHAs (2 FGDs; n=20), Anganwadi Workers (2 FGDs; n=16)	Cadre-specific group discussions	Explore shared work experiences, workload, coordination, and perceived feasibility
Administrative inputs	4 non-formal interviews with senior district/programme officials	Programme and administrative stakeholders	Understand governance, coordination, and system-level constraints

Table 1: Sampling units across the quantitative and qualitative rounds of data collection

Beneficiaries across the three rounds of household surveys in the learning block were predominantly above the poverty line (82.0%), with high access to improved sanitation (98.1%) and drinking water (99.7%), although reliance on biomass fuel remained substantial (55.3%) **(Table 2)**.

Details of respondents	Total N=1744 (%)
Ration card Type	
APL	1430 (82.0)
BPL	220 (12.6)
AAY	19 (1.1)
No card	75 (4.2)
Water Source	
Bottled	1 (0.1)
Close Well	12 (0.7)
Piped Water	1517 (87.0)
Surface Water	3 (0.2)
Open well	1 (0.1)
Tube Well/Borehole/Hand Pump	208 (11.9)
Others	2 (0.1)
Toilet access	
Flush or pour flush toilet	1711 (98.1)
No Facility	23 (1.3)
Pit latrine	10 (0.6)
Main Cooking fuel used in Household	
Dung Cakes	1 (0.1)
Electricity	5 (0.3)
Kerosene	0 (0.0)
LPG	774 (44.4)
Wood	964 (55.3)

Table 2: Distribution of beneficiaries assessed in household survey according to their ration card ownership, drinking water source, toilet access and cooking fuel usage.

Across the continuum of care, a pattern emerged: maternal, newborn, and nutrition services were largely present within the public system, but coverage and functional quality varied across levels and stages of care. Preconception care is largely absent as a recognised social concept and also not operationalised as a structured public-sector service. The formative findings have thus been

organized as stage-specific findings along the care continuum (preconception through postnatal care and nutrition), and cross-cutting constraints: care-seeking and trust, access, information systems, and workforce, that shaped service delivery at every stage. For each, we identify the implication for adapting the WINGS intervention for scale-up.

Preconception- the unnoticed window

"Pregnancy by chance, not by choice": The concept of accessing healthcare before pregnancy was extremely limited. Across all interviews, women only accessed antenatal services after pregnancy was detected. Medical officers reported that counselling to delay pregnancy- particularly among women who were undernourished or ill- was generally not provided, as women rarely approached facilities during the preconception period. Care was sought by individuals experiencing infertility rather than by couples seeking guidance before planning pregnancy. Although counselling on maintaining a minimum interpregnancy interval of three years was reported, conception was often perceived as incidental than intentional. Conversations with both beneficiaries and providers reflect the prevailing perception that pregnancies are more often unplanned than deliberately intended.

"You know, there is generally no planning here when it comes to having children. Children are often conceived without prior planning. Unlike in cities, where people tend to plan their families, such practices are rare in rural setups." - Postnatal woman

"*Advice… is given to maintain 3 years of minimum gap.. Family planning counselling is not given at the facility because people don't even come here for that.. the pregnancy is by chance not by choice."*- Block Medical Officer

Household survey data gave quantitative weight to this finding. Among 428 preconception women, 84.3% reported taking no nutritional supplements of any kind, and only 9.8% were consuming iron and folic acid- compared with 89.3% of pregnant women. A striking double burden of obesity and dietary deficiency was noted: 41.8% of preconception women had a BMI over >25kg/m^2, while 62.4% suffered from anemia. Awareness of preconception services was limited

and uneven, ranging from 10.3% for multivitamin provision and 18.2% for mental health counselling to 54.0% for iron and folic acid tablets and 58.9% for treatment of a health condition. Among women who were aware of a given service, most had used it (52.3-85.5%), indicating that awareness rather than conversion from awareness to uptake was the principal constraint. **(Figure 3)** Facility assessment confirmed that no structured preconception services existed at any level of the public health system in the learning block. These findings demonstrate that preconception health is neither socially conceptualised, nor institutionally operationalised as a distinct phase of care. This near-total absence of preconception care seeking and services presents the major adaptation challenge for WINGS scale-up.

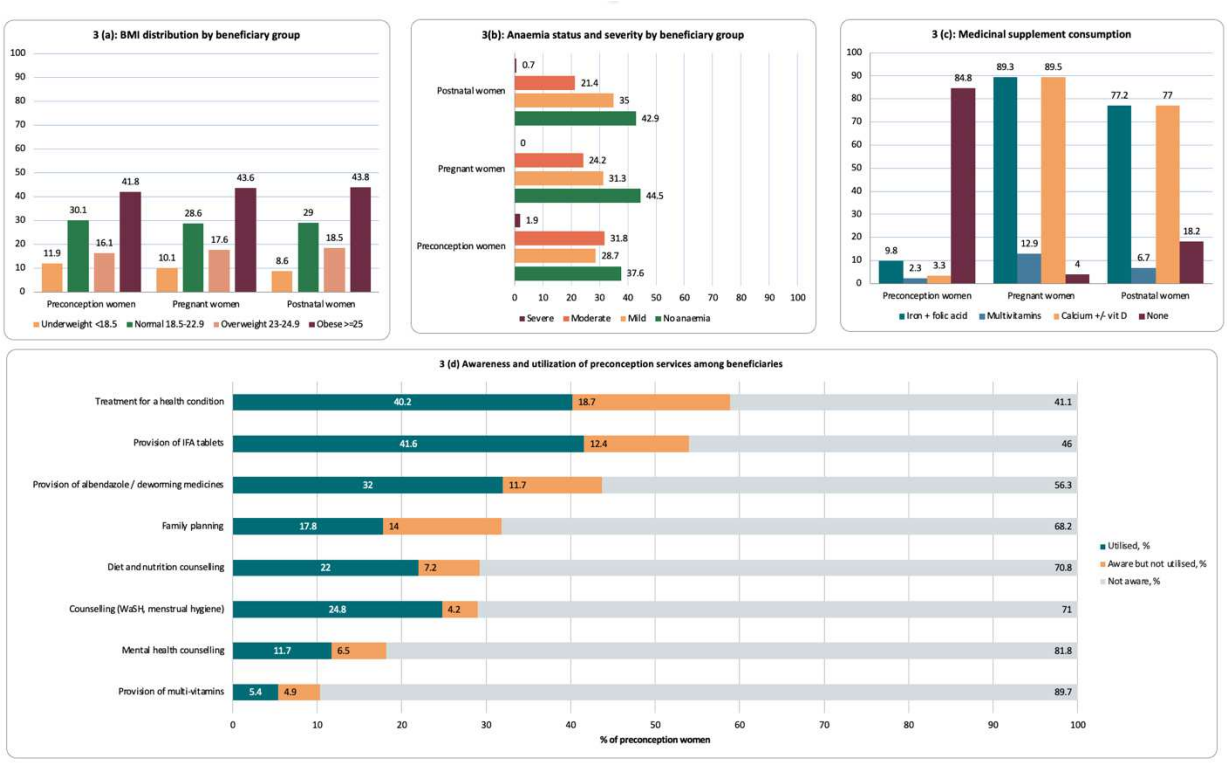


Fig 3: Baseline distribution of a) BMI, b) anemia status and c) supplement consumption habits of beneficiary women. Figure 3 d) depicts the awareness and utilization of health services among preconception women

Points of possible preconception contact: ASHAs reported maintaining regular contact with newly married couples, during which they provided information on family planning, supplied contraceptives when available, and encouraged early pregnancy registration. However, among

the preconception women interviewed, none reported being offered contraceptive methods, including women undergoing treatment for anemia or fibroids, which may indicate a social desirability bias among field workers interviewed. While advice to delay pregnancy until health conditions improved was sometimes provided- particularly in the private sector- this was not accompanied by preconception counselling or disease management.

Antenatal fragmentation of care

Four antenatal care visits were recommended and generally followed, with several women reporting more than four visits, including visits under the Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA). However, PMSMA clinics were often perceived by both providers and beneficiaries as substitutes for routine antenatal care rather than as supplementary services, resulting in missed follow-up visits. The household survey showed that 1st trimester registration of ANC across all rounds was 68.7%, which is close to the value reported for Una district in NFHS-5.[20]

"I bring 1st, 2nd and 3rd trimester women to PMSMA clinics.. They are screened for high risk and given general checkup there itself." - ASHA worker

This has long-reaching consequences, since PMSMA has been tailored to detect high-risk pregnancies with fortnightly sessions. ANC sessions are weekly, and essential to ensuring early registration in the first trimester, with timely screening of late gestational complications.

Category	Number (%; 95% C.I.) n=98*
Adequate weight gain	37 (37.8; 28.8-47.6)
Inadequate weight gain	61 (62.2; 52.4-71.2)

**data available for 98 cases*

Table 3: Gestational weight gain among pregnant women in household survey

Routine antenatal investigations were available free of cost through a hub-and-spoke laboratory model up to CHC level, facilitated by a public-private partnership by the district administration. However, ultrasound services were inconsistently available in public facilities, leading many women to depend on private centres. Mental health screening and monitoring of gestational

weight gain were not reported, even though the household survey showed that inadequate gestational weight gain was a significant concern affecting 61 of the 98 participants assessed **(Table 3)**. Low body mass index was not classified as a high-risk condition. WaSH and psychosocial counselling were not performed routinely for any beneficiaries.

"*This PHC has recently started offering.. blood and urine tests. So patients from nearby PHCs are coming here sometimes."*- Medical officer

"*We have requisitioned (an) ultrasound machine already.. Weekly ultrasounds will be started soon."*- Block Medical Officer

Since PMSMA is treated as a substitute for routine ANC, and clinical screening is inconsistent, WINGS will need to reposition PMSMA as supplementary and embed standardised screening into every pregnancy contact during ANC sessions.

Institutional gaps in intrapartum care

Provision of intrapartum services within the public health system was limited across the district. Of the six PHCs assessed, none reported conducting deliveries. This leads to referrals to the CHCs and CH Amb, where caesarean section services were unavailable at the time of study. Within the public sector, caesarean deliveries were conducted exclusively at the Regional Hospital (RH) Una, while several private facilities provide this service.

Coverage of maternal and newborn services varied across facilities. At CH Amb, 62.8% of pregnant women had at least four ANC visits and 56.4% delivered at the facility. Low birth weight and preterm birth were recorded in 17.4% and 19.9% of cases, respectively. At CH Chintpurni, 18.2% of women were referred during ANC, only 5.2% completed at least four ANC visits, and 29.9% had institutional deliveries. At the CHC, only 3.5% completed four ANC visits and no institutional deliveries were recorded. None of the facilities documented eight ANC visits. No early neonatal deaths were reported; however, several indicators were unavailable or inconsistently recorded.

Variable	CH Amb n=282 n (%; 95% C.I)	CH Chintpurni n=77 n (%; 95%C.I)	CHC n=85 n (%; 95% C.I)
Pregnant women referred during ANC	0 (0.0; 0.0-1.3)	14 (18.2; 11.2-28.2)	-
Pregnant women with at least 4-ANC check-ups	177 (62.857.0-68.2)	4 (5.2; 2.0-12.6)	3 (3.5; 1.2-9.9)
Pregnant women with at least 8-ANC check-ups	0 (0.0; 0.0-1.3)	0 (0.0; 0.0-4.8)	0 (0.0; 0.0-4.3)
Women given corticosteroids for preterm labor	0 (0.0; 0.0-1.3)	0 (0.0; 0.0-4.8)	-
Registered antenatal mothers who came for delivery	0 (0.0; 0.0-1.3)	0 (0.0; 0.0-4.8)	0 (0.0; 0.0-4.3)
Institutional deliveries (In facility)	159 (56.4; 50.5- 62.0)	23 (29.9; 20.8-40.8)	0 (0.0; 0.0-4.3)
Home deliveries	0 (0.0; 0.0-1.3)	0 (0.0; 0.0-4.8)	-
Maternal deaths	-	0 (0.0; 0.0-4.8)	-
Babies with very low birth weight (VLBW) < 1,500 g	1 (0.4; 0.1-2.0)	0 (0.0; 0.0-4.8)	-
Babies born with low birth weight (LBW) < 2,500 g	49 (17.4; 13.4-22.2)	0 (0.0; 0.0-4.8)	-
Preterm babies born (<37 weeks)	56 (19.9; 15.6-24.9)	0 (0.0; 0.0-4.8)	-
Early neonatal deaths (within 24 hours of birth)	0 (0.0; 0.0-1.3)	0 (0.0; 0.0-4.8)	-

(Data not available marked as "-")

Table 4: Intrapartum indicators noted from delivery points during facility assessment.

The district hospital was equipped with a Kangaroo Mother Care (KMC) unit, and reportedly used for low birth weight infants. However, formal reporting and documentation of KMC practices were not routinely maintained, despite 17.4% children born with low or very low weight. **(Table 4)**

Postnatal care focused on infant care

Postnatal home visits were universally conducted by ASHA workers, with most women receiving an initial visit within 2-3 days of discharge **(Table 5)**. These visits focused mainly on procedural tasks such as weight measurement and immunization enquiry, while follow-up visits were variable across ASHAs **(Tables 6 & 7)**. HBYC visits are conducted jointly by the ASHA and AWW. These visits were limited, and Anganwadi Worker (AWW) involvement was inconsistent.

"*I was asked (during home visit) if I have any problems, and I said no. That is all.*"- Postnatal mother

	n=434 (%; 95% C.I)
Yes – Reported	224 (51.6; 46.9-56.3)
Yes – Documented	175 (40.3; 35.8-45.0)
No	35 (8.1; 5.9-11.0)

Table 5: HBNC visits recorded among postnatal womening household surveys.

	n=434 (%)
Positioning during feeding	268 (61.8)
Attachment	338 (77.9)
Sucking	210 (48.4)
Expressing breast milk	158 (36.4)
Feeding expressed milk	122 (28.1)
Management of complications	51 (11.8)
None	28 (6.5)

Table 6: Details of counselling during HBNC for postnatal women in household surveys.

HBNC days	n=399 (%)
Day 1	27 (6.8)
Day 3	239 (59.9)
Day 7	318 (79.7)
Day 14	279 (69.9)
Day 21	236 (59.1)
Day 28	199 (49.9)
Day 42	172 (43.1)
Other	16 (4.0)
Staff visiting for HBNC	
ASHA	391 (98.0)
ANM	2 (0.5)
AWW	228 (57.1)
Staff Nurse	1 (0.3)

Table 7: HBNC visit days and attendant staff as recorded in postnatal women's MCP cards (n=399 women who were >6 weeks postnatal)

ASHA workers were knowledgeable about breastfeeding and attachment, and beneficiaries also reported understanding the importance of breastfeeding. This finding was echoed in the household survey, where 80% of children between 6-24 months were exclusively breastfed up to 6 months **(Table 8)**, higher than the state average of 70%.[20] Notably, some women reported that postnatal follow-up focused predominantly on newborn-related indicators, with limited attention to comprehensive maternal health assessment and counselling. This was confirmed

during household visits, when women reported being counselled about breastfeeding extensively, but not about complications she or the baby may face **(Table 6).** Adaptations for scale-up would ideally focus on strengthening these home visits to ensure quality screening and counselling.

Category	N=449 (%)
0-5 months	75 (16.7)
6+ months	363 (80.8)
Don't know	11 (2.5)
Mean: 5.35 months; **Median:** 6.0 months; **IQR:** 6.0-6.0	

Table 8: Round-wise and net pattern of exclusive breastfeeding among 6-24 month children.

Supplementary nutrition: available platform, uneven uptake and consumption

Anganwadi centres were the main platform for supplementary nutrition. Under ICDS, pregnant and lactating women and children aged 6 months to 3 years received Take-Home Rations, while children aged 3-6 years received hot cooked meals. At the time of formative assessment, preconception women were not eligible for supplementary nutrition, although they are a key WINGS target group.

It is important to distinguish system availability, beneficiary receipt, and actual consumption by the intended person. THR was available through AWCs and most pregnant women reported registration after pregnancy confirmation. Across all rounds of the survey, an overwhelming majority reported receiving take home ration from Anganwadis **(Table 9)**.

Supplementary nutrition given at AWC	Pregnant women (n=428)	Postnatal women (n= 434)	6-24 m children (n= 267)
Yes	403 (94.2)	419 (96.5)	259 (97.0)
No	25 (5.8)	15 (3.5)	8 (3.0)

Table 9: Access to supplementary nutrition at Anganwadi centre across beneficiary groups (preconception women did not receive any supplementary ration at the time of formative study)

However, receipt did not ensure that the ration was complete, acceptable, or consumed by the pregnant woman or child for whom it was intended. Several Anganwadi workers noted that some

staple rations were provided more often than others, regardless of cultural and local preferences or dietary needs **(Table 8S)**

"For instance, if a mother is supposed to be given four items, she's only given two- so she's not getting full nutrition from just those two." - Anganwadi worker

Quality and quantity concerns were reported by Anganwadi Workers and beneficiaries, including supply irregularity, loose packaging, variable quality, and incomplete ration packages. Workers also described insufficient tailoring of food items by age, physiological status, or nutritional need. For example, some foods provided to young children were perceived as unsuitable for their age. The surveys of beneficiaries showed that all beneficiaries- pregnant and postnatal women, as well as children between 6 months and 2 years of age- received the same distribution of rations **(Table 9S).** It also showed that 44.4% (115/259) children shared the take home rations with the entire family.

"Now for a six month old, we give rajma (kidney beans).. A baby can't eat that now." - Anganwadi worker

Acceptability varied by item. Milk was widely accepted and culturally valued, but powdered milk was poorly accepted because many households preferred fresh animal milk and did not perceive reconstituted powdered milk as equivalent. Egg consumption was culturally sensitive in some areas, especially where Anganwadi centres were near temples. Household survey data supported these qualitative findings: egg consumption among all women across all rounds was just over 20%, while milk consumption was 94.3% **(Table 10)**. Some respondents also reported poor palatability of rajma, chana dal, and shakkar.

	Eggs	**Milk**
Preconception women (n=428)	78 (18.2)	386 (90.2)
Pregnant women (n=428)	83 (19.4)	407 (95.1)
Postnatal women (n=434)	100 (23.0)	424 (97.7)
Total (N=1290)	261 (20.3)	1217 (94.3)

Table 10: Net consumption of milk and eggs in all three women beneficiary groups

Intra-household sharing further reduced the intended nutritional benefit. Rations were often shared with other family members rather than reserved for the pregnant woman, lactating woman, or young child. These findings show that supplementary nutrition strategies must include family counselling on targeted consumption, not only distribution monitoring.

Growth monitoring was routinely reported, but identification and referral of SAM/MAM were weak. Several Anganwadi centres had non-functional or outdated anthropometric equipment; functional baby weighing scales and infantometers were available in 63.9% of assessed centres. Workers sometimes borrowed equipment from neighbouring centres. Facility providers reported that malnutrition was more often identified incidentally during illness visits than referred from Anganwadi centres.

Service readiness, access, and public-sector trust

The formative assessment showed that the public system had important structural assets, including an established frontline workforce, routine antenatal platforms, home-visit programmes, HWC-AAMs, and Anganwadi centres. However, service readiness was uneven across the continuum. Private-sector use was substantial. More than half of deliveries among surveyed participants occurred in private facilities, compared with the reported state average of 16.4%.[20] Women and key informants described shorter waiting times, better perceived cleanliness, more predictable doctor availability, and fewer referral steps as reasons for private-sector preference. This finding should be interpreted as a combination of access constraints and perceived quality concerns, rather than as a simple rejection of public services.

The qualitative findings explained why physical availability of public facilities did not always translate into utilisation. Women reported difficulty waiting for long periods during pregnancy and uncertainty about whether doctors would be available. Border-area residents sometimes found private facilities closer than public referral facilities. Narratives of adverse experiences in public facilities also circulated within communities and influenced usage patterns. These findings should

inform the sensitization phase of the behaviour-change strategy, particularly by addressing community perceptions of public-sector quality.

"*We don't go to government facilities. There is a private hospital.. where we go from the beginning. Government hospitals take too much time - we have to wait a lot, and there is no fixed timing for when the doctor will be available*." - Postnatal woman

Women from migrant and daily-wage households were more likely to miss scheduled visits due to work-related constraints. Several women reported accessing antenatal care at private facilities, citing proximity and shorter waiting times.

"We do go to government facilities, but there are many problems. We have to wait the entire day, doctors are often unavailable, and it's difficult to sit for long periods.. during pregnancy. The whole experience becomes very uncomfortable."- Pregnant woman

Barriers to access

Access to transport: Transportation emerged as a significant local factor influencing both service delivery and care-seeking in the study area. Limited availability of public transport compelled many healthcare providers and community health workers to commute on foot or use their own vehicles to reach facilities and community catchment areas. ASHAs reported covering large and, in some cases, hilly and remote habitations located up to six kilometres from their base. On average, ASHAs covered catchment areas spanning three to four kilometres, with most relying primarily on walking; those who owned two-wheelers used them to facilitate mobility.

"There's a transportation issue here… I mean, there isn't even a bus available here" - CHO

"*There is no other way to get there.. (we) have to go with the ASHA in the auto, and each trip costs 50 rupees."* - Pregnant woman

From a beneficiary perspective, access to health facilities varied based on transport availability and affordability. Despite 87% of all surveyed households owning 2-wheelers, and 38% owning cars, the issues faced by beneficiaries reflected their dependence on family members for transport. In the absence of public transport or personal vehicles, some beneficiaries reported

resorting to rented vehicles, which imposed a substantial financial burden. While ambulance services were available for pregnant women, routine visits for antenatal and other health services largely depended on sporadic availability of public transport or family-owned vehicles.

Weak social support systems: Even though household surveys showed that 82.6% of all respondents lived in extended or joint families, participants reported low social support during interviews, a paradox that likely reflects evolving household dynamics. Joint family structure may no longer translate into the practical and decision-making support that women need to attend antenatal visits, particularly when spouses are engaged in work or when elder family members are not actively involved in maternal health decisions. Women with young children often brought them along to antenatal care visits, which made travel and facility visits more challenging, particularly when no accompanying support was available. Additionally, women reported difficulties travelling alone for healthcare visits when spouses were occupied with work, especially in households without personal vehicles.

"*..I go for checkups, and there is nobody home.. Where will I leave my child? He is too small for (going to) school."*- Pregnant woman

Because mobility and social-support constraints limit attendance independent of service availability, demand-side strategies should target households rather than individual women, engaging spouses and senior family members as active participants in care-seeking rather than assuming that family presence equals to family support.

Documentation gaps and workforce shortages

ASHAs and Anganwadi Workers are central to WINGS delivery, but they operate within substantial operational constraints. Transport barriers affected both service delivery and care-seeking. ASHAs described walking long distances, sometimes through hilly and dispersed habitations, to reach households. Beneficiaries also depended on family members or hired transport for routine visits, even when two-wheelers were available within the household.

Documentation systems were present but not consistently functional. MCP card possession among pregnant women was higher in later formative rounds, varying from 63.3% in Round 1 to 91.9% in Round 3. However, among women with MCP cards, complete filling remained low, increasing only from 4.2% to 24.0%. **(Table 11)** Because the surveys were repeated cross-sectional formative assessments conducted before WINGS implementation, this should not be interpreted as an intervention effect. Higher card availability in later rounds may reflect routine system processes, replenishment of card supplies, and concurrent engagement with government stakeholders around documentation and supply availability. The key finding is that cards were increasingly available, but their functional use for complete maternal tracking remained weak.

	Round 1 n (%) (n= 150)	**Round 2 n (%) (n = 135)**	**Round 3 n (%) (n=136)**	**Total (N=421) N (%)**
Availability of MCP cards	95 (63.33)	102 (75.6)	125 (91.9)	322 (76.5)
Completion of documentation in requisite fields	**Round 1 (n=95) n (%)**	**Round 2 (n=102) n (%)**	**Round 3 (n=125) n (%)**	**Total (N=322) N (%)**
	4 (4.2%)	5 (4.9)	30 (24.0)	39 (12.1)

Table 11: Availability and complete documentation in MCP card among pregnant women

Qualitative data suggested several reasons for documentation gaps: temporary MCP and HRP card shortages, use of photocopied pages, reliance on ASHA registers, difficulty entering data into digital portals, and limited access to desktops or stable digital infrastructure at HWC-AAMs. These issues indicate that documentation strengthening requires not only supplies, but also digital support, supervisory checks, and clear use of records for referral and follow-up.

"We keep entries in our diaries and give women photocopies.. But they are lost easily. How will you keep one sheet (for) nine months?"- ASHA worker

Human-resource vacancies and deputations added to workload. In the learning block, 7 of 37 sanctioned Medical Officer posts were vacant at the time of data collection. Respondents described frequent transfers and deputations, overburdened doctors, and intermittent closure of some centres when CHOs were deputed elsewhere.

"It seems that no one prefers to be posted in this area… the region itself is somewhat remote. Those who do come often get themselves transferred soon after. This could potentially be the reason for the vacancy." - CHO

Qualitative interviews suggested that documentation gaps were driven by temporary card shortages, reliance on photocopied sheets, and digital barriers within facilities. CHOs reported difficulty entering data into the RCH portal because most HWCs lacked desktop systems, while ASHAs and AWWs preferred paper documentation due to limited familiarity with digital applications. Together, these findings suggest that although maternal tracking systems were structurally present, continuity and functional use of documentation systems remained inconsistent across levels of care.

Human resource shortages emerged as a key constraint across health facilities in the district. Vacancies were reported across multiple cadres, including Medical Officers, CHOs, male and female health workers, and laboratory technicians. Respondents attributed these vacancies partly to the remoteness of certain areas, with staff often seeking transfers shortly after appointment. Frequent deputation of CHOs to other Health and Wellness Centres leads to intermittent closure of their assigned centres, causing inconvenience to beneficiaries. Overall, staff shortages and high emergency caseloads resulted in overburdened doctors, disrupted outpatient services, and compromised delivery of routine maternal and child health services.

A few medical officers suggested recruiting ASHAs for WaSH and psychosocial counselling and screening, since they are in regular touch with the population. Senior administrative officials suggested extending the PPP model of hub and spoke laboratories to the PHC level.

Platform/domain	Readiness assets	Main gaps identified	Implication for WINGS
Preconception services	ASHAs have contact with newly married couples; existing VHND/AWC platforms	No structured preconception service package; low supplement use; care-seeking begins after pregnancy	Create visible preconception entry points and screening/counselling package

ANC and maternal tracking	Early registration reported; PMSMA platform; MCP/HRP card system exists	PMSMA may substitute for routine ANC; incomplete MCP filling; no routine GWG/psychosocial/WaSH counselling	Clarify ANC schedule, strengthen card completion, add WINGS counselling modules
Laboratory and screening	Hub-and-spoke tests available up to CHC in some locations	RTI/HIV screening not routine; ultrasound inconsistent; low BMI not routinely treated as high risk	Standardise risk screening and referral protocols
Delivery and immediate PNC	Some public and private delivery facilities available; district KMC unit present	Few public delivery points; caesarean services concentrated outside block; formula use observed; KMC documentation weak	Strengthen referral planning, breastfeeding counselling, and KMC documentation
HBNC/HBYC	ASHAs conduct early postnatal visits; HBYC platform exists	Visits often procedural; limited maternal counselling; AWW involvement inconsistent; HBNC documentation absent in reviewed MCP cards	Use visit checklists, regular supervision, and clearly defined referral and follow-up linkages between ASHAs and AWWs
ICDS nutrition platform	THR available for pregnant/lactating women and children; growth monitoring routine	No preconception THR; supply/quality concerns; palatability issues; intra-household sharing; equipment gaps; weak SAM/MAM referral	Tailor nutrition package and counselling; strengthen equipment, monitoring, and referral linkage

Table 12: Facility assessment findings and implications for WINGS scale-up

Discussion

This convergent mixed-methods formative study identified key barriers and facilitators relevant to the scale-up of the WINGS intervention in Amb block, Una district, across the continuum from preconception to early childhood. The central finding is that the system has multiple potential delivery platforms, but their functional readiness is uneven. Preconception care is not yet a visible service category; private-sector use is substantial; frontline workers face workload, mobility, documentation, and equipment constraints; supplementary nutrition is available but not always acceptable, complete, or consumed by the intended beneficiary; and the continuum from pregnancy to early childhood is fragmented in practice.**(Table 12)**

These findings yielded four evidence-based priorities to guide the adaptation of the WINGS model for scale-up. First, preconception care should be repositioned as a distinct service category, achieved through targeted social and behaviour change communication (SBCC) and systematic outreach by frontline workers. Second, the coordination between ASHAs and Anganwadi Workers must be strengthened to ensure continuity of care across the preconception to early childhood continuum. Third, nutrition counselling and supplementation protocols should be revised to account for locally prevalent dietary norms and beliefs, as well as the dual burden of anemia and obesity observed within the target population. Fourth, existing documentation practices and referral pathways require improvement to convert established service contacts into effective points for continuum-of-care delivery.

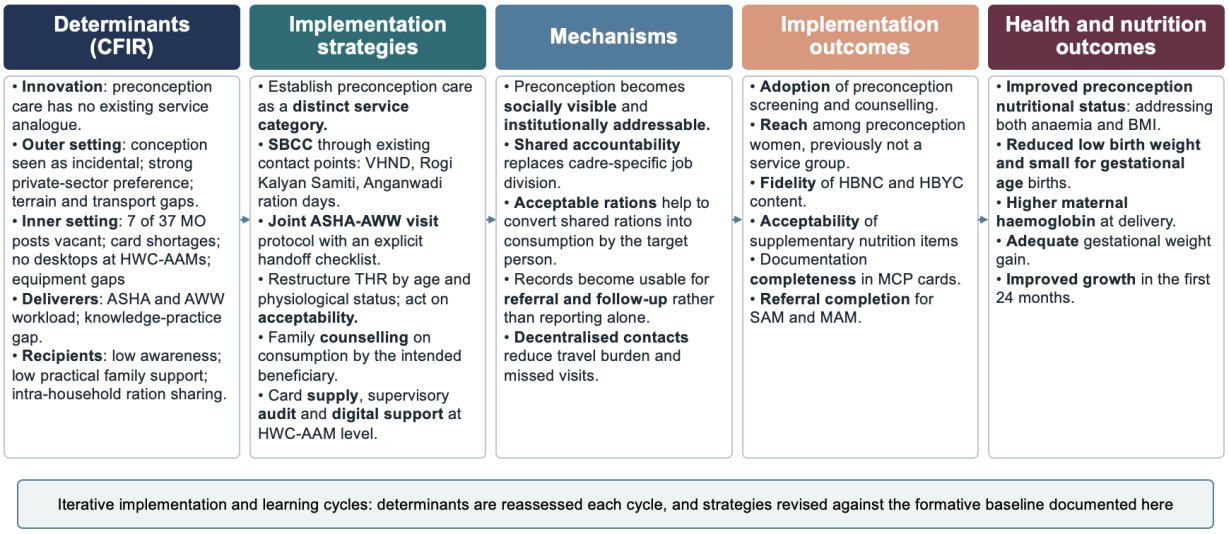


Fig 4: Implementation Research Logic Model (IRLM) showing the determinants, possible strategies, proposed mechanisms and intended outcomes as mapped after the formative study.

Invisibility of preconception

Low awareness of the preconception period as a distinct and actionable phase for health intervention emerged as a fundamental barrier in this study. Pregnancies were commonly perceived as incidental and largely unplanned, preconception care-seeking was virtually absent, and no structured preconception services existed at any level of the public health system within

the learning block. The invisibility of preconception care in Amb is consistent with evidence from South Asia and other LMIC settings showing that women and families often engage with health services only after pregnancy recognition. This creates a missed opportunity because many determinants of fetal growth and maternal risk are already present before antenatal registration.[21] The gap between preconception and antenatal care explains a broader normative orientation in which reproductive health was seen as something that happened to women, rather than something that could be actively prepared for. Addressing this will require simultaneous demand-side sensitisation and supply-side readiness, an approach supported by evidence from preconception interventions in comparable settings.[22] In this setting, sensitization can be embedded in existing contact points- like village health and nutrition days, Rogi Kalyan Samiti meetings, and Anganwadi ration days. The regular contact between ASHAs and newly married women is an entry point for screening and counselling. Repurposing existing platforms, rather than creating new ones, is likely to be more sustainable within a resource-constrained system. Additionally, mass screenings at village and PHC level can be conducted on a regular basis.

Private sector preference and public trust

One of the most important findings of this study was that private-sector use was substantial and appeared to reflect both access constraints and perceived quality concerns in the public sector. More than half the deliveries in the study population occurred in private facilities and women reported seeking antenatal care from private providers, citing long waiting times, doctor unavailability, and concerns regarding infrastructure in government facilities. This pattern aligns with a growing body of evidence from India demonstrating increasing private sector preference in maternal healthcare, driven less by cost and more by perceptions of quality, responsiveness, and respectful care.[23]

These preferences are not shaped by individual experiences alone. Narratives of anecdotal experiences circulate widely within communities and substantially influence care-seeking behaviour. This reflects the established role of social networks and collective community

experiences in shaping trust and facility choice in South Asian healthcare settings.[24] These findings should inform the sensitisation phase of the behaviour-change strategy, particularly by addressing community perceptions of public-sector quality and trust. Adaptations for the WINGS intervention should focus on improving the accessibility and perceived quality of public-sector services to address preferences for private healthcare facilities. Simultaneously, engagement with private providers may be necessary to ensure continuity of intervention coverage among beneficiaries who are unlikely to return to the public system.

High burden and low workforce

ASHAs and Anganwadi Workers, the operational backbone of the health and ICDS systems, represented one of the most significant implementation bottlenecks. Serving geographically dispersed catchment areas, even traversing on foot, their work is made more difficult by human resource vacancies in MO and CHO cadres, fragmented documentation mechanisms, limited digital literacy support, and non-functional equipment. These findings are consistent with the broader literature, which identifies workload, supervision, and infrastructural support, rather than motivation alone, as key determinants of service quality.[25]

A consistent knowledge-practice gap was observed across cadres. ASHAs were often able to describe neonatal danger signs but did not routinely assess for them during home visits. Similarly, Anganwadi Workers conducted growth monitoring activities but rarely identified or referred SAM and MAM cases. This gap cannot be explained solely by deficiencies in training. Evidence from LMIC health systems suggests that functional referral pathways, supervisory reinforcement, and task clarity are equally critical in enabling translation of knowledge into practice.[26]

The cultural implications of nutrition

Although supplemental nutrition delivery through Take-Home Rations appeared structurally regularised, it did not consistently lead to individual consumption. Rations were frequently shared within households, several distributed food items were considered culturally inappropriate during pregnancy, and beneficiaries often rejected items such as powdered milk, eggs, or rajma on

grounds of taste or acceptability. These findings reflect a well-documented phenomenon within South Asian nutrition programmes, wherein household food dynamics, culturally embedded dietary beliefs, and household level decision-making structures predate formal supplementation systems and frequently undermine intended nutritional benefits.[27,28]

The observed coexistence of obesity and anemia among preconception women further highlights the complexity of nutritional deficiency within this population. While 41.8% of women were obese according to Asian BMI cut-offs, 62.4% were anemic. This double burden of malnutrition is increasingly reported in women of reproductive age in India but remains poorly addressed within standard supplementation frameworks designed primarily for undernutrition.[29]

Current IFA and THR protocols are inadequately aligned with the nutritional realities observed in this setting. WINGS scale-up must incorporate dietary counselling sensitive to both overnutrition and micronutrient deficiency. Supplementation strategies have to be tailored to preconception women, who currently receive virtually no nutritional support. Complete and regular THR supply, food items tailored to beneficiary groups, improving acceptability of distributed foods, counselling families to promote consumption by the intended beneficiary, ensuring functional anthropometric equipment, and strengthening AWW-ASHA-facility referral pathways for undernutrition would strengthen the system while also meet the aims of the scale-up program.

Continuum of care in policy, not practice

There was a notable fragmentation observed across the entire continuum from preconception to early childhood. Formal structures existed in principle but functioned incompletely in practice. PMSMA clinics frequently substituted for rather than supplemented routine antenatal care, and delivery points were few and far between. HBNC visits were widely implemented but often procedural in nature. HBYC visits lacked consistency. SAM and MAM cases were primarily detected at higher facilities rather than at Anganwadi centres. Psychosocial and WaSH counselling were almost entirely absent across the continuum. This pattern reflects an “execution gap”- the discrepancy between policy and actual delivery at the point of care.[30]

Addressing this gap will require more than training and supply-side strengthening alone. Deliberate redesign of handoff processes between health and ICDS systems, strengthened ASHA-AWW coordination, and routine monitoring of continuity indicators will be essential. The WINGS scale-up model, with its iterative cycles of implementation, learning, and adaptation, is well positioned to address these gaps systematically, provided the baseline fragmentation documented here is explicitly incorporated into programme planning.

Strengths and limitations

This study has several important strengths. The convergent mixed-methods design enabled triangulation across quantitative and qualitative data sources, thereby strengthening the validity of findings. Use of the CFIR framework provided a structured approach for identifying barriers and facilitators across multiple levels of the health system. Data collection spanned three rounds of household surveys, detailed facility assessments, and qualitative interviews involving beneficiaries, frontline workers, and senior administrators, enabling a comprehensive multi-level understanding of implementation readiness.

Several limitations should also be acknowledged. The study was conducted within a single block of one district, which may limit transferability of findings to other geographic and health system contexts. Qualitative interviews were conducted by researchers with prior involvement in WINGS programme activities; although measures such as role separation, standardised interview guides, and reflexive discussions were undertaken to minimise bias, the possibility of social desirability bias among providers cannot be excluded.

The household surveys were designed as repeated cross-sectional assessments and did not follow the cohort of beneficiaries longitudinally over time. Therefore, the findings should not be interpreted as individual-level changes in knowledge, practices, service use, or nutritional status. In the context of implementation research, the purpose of these repeated cross-sectional surveys was to assess population-level coverage and service-use patterns at each formative time point. Round-wise estimates therefore reflect the status of programme-relevant indicators in the target

population at different points in time, rather than within-person change. As beneficiary groups and household samples differed across rounds, observed differences across survey rounds should be interpreted as descriptive population-level coverage patterns and not as causal effects or longitudinal trends among the same individuals. Cross-sectional household surveys cannot establish temporal trends, and hence this paper refrained from commenting on changes through time. Beneficiary reclassification between the household survey rounds, resulting from transitions in pregnancy and postpartum status, may have introduced variability in group composition over time. In addition, gestational weight gain data were available for fewer than one-quarter of pregnant women, limiting the strength of conclusions in this area. In 21.3% cases, the current weight was lesser than the weight documented in ANC records for the 1st trimester. It may be due to lack training for measurement of accurate weight or may be due to error in weighing scale. Self-reported service utilisation may be affected by recall and social desirability bias among participants.

Finally, although CFIR provided a useful organising framework, its origins within high-income healthcare systems meant that several constructs require adaptation for the resource-constrained rural setting of Himachal Pradesh, a limitation increasingly acknowledged in implementation science literature examining CFIR application in LMIC settings.[31]

Conclusions

This formative study provides a comprehensive baseline assessment of the contextual determinants influencing WINGS scale-up in Una district, Himachal Pradesh. While the health system possesses important structural assets- including an established frontline workforce, functional primary healthcare infrastructure, and existing ICDS platforms- substantial gaps exist in preconception awareness, nutritional protocol adequacy, public sector trust, and integration across the continuum of care.

These findings inform adaptation of WINGS implementation strategies within routine health system settings, including the need for demand-side preconception sensitisation, culturally

responsive nutritional interventions, and deliberate redesign of continuity and referral pathways across the maternal and child health continuum. **(Figure 4)**

As WINGS scale-up progresses through iterative implementation and learning cycles, the baseline documented in this study will provide a critical reference point against which programme adaptation, systems strengthening, and improvements in service coverage can be evaluated, and similar implementations in other regions can be guided. **(Table 13)**

CFIR domain → construct	Quantitative indicator	Qualitative theme with supporting quotes	Integration	Adaptation implication
Individuals (recipients): motivation, need **Outer Setting:** local attitudes	Household survey: 84.3% preconception women took no supplements; only 9.8% took IFA.	Preconception care neither sought nor recognised, conception perceived as incidental than planned. *"Pregnancy by chance, not by choice."*	Absence of preconception supplementation matches near-total absence of preconception care-seeking in interviews.	Establishment of preconception care should be linked with awareness generation to create beneficiary-side demand.
Innovation: compatibility **Inner Setting:** available resources	Facility assessment: no structured preconception services at any level across 16 health facilities + 72 AWCs.	Medical officers report no preconception counselling; care only for infertility, not pre-pregnancy planning.	The health systems has no existing service; structural gap confirmed both on service and beneficiary side.	
Inner Setting: relational connections **Individuals (deliverers):** opportunity	-	ASHAs maintain regular contact with newly married couples (family planning, early registration).	Qualitative methods identified a delivery channel missed quantitatively.	ASHAs can be instrumental in identifying preconception women in the community.
Inner Setting: compatibility, communications	≥4 ANC visits generally achieved, but GWG assessed only in 98 women, inadequate in 61; moderate anemia in 24.2% women.	PMSMA treated as a substitute for, not supplement to, routine ANC: *"I bring 1st, 2nd and 3rd trimester women to PMSMA clinics."*	Screening and management gaps noted, explained by the substitution mechanism behind them.	Importance of weekly ANC sessions should be reinstated; gestational weight gain should be a priority indicator during checkups.

Individuals (deliverers): capability, motivation **Inner Setting:** access to knowledge, relational connections	Universal early ASHA postnatal visit; HBNC documentation absent from MCP cards reviewed.	**Knowledge-practice gap**: danger signs known but not actively screened. *"I was asked if I have any problems, and I said no. That is all."*	Home visits are regularly conducted, but inadequately documented; active screening replaced with perfunctory checks.	Home visits can be a crucial leverage point for intervention delivery; maternal health, psychosocial well being and child growth can be assessed at these contacts.
Outer Setting: local conditions, local attitudes **Innovation:** relative advantage	>50% of deliveries in private settings vs 16.5% state average; most ANC sought privately.	**Relative ease** and comfort in private settings; **adverse-event narratives** circulate. *"Government hospitals take too much time… no fixed timing."*	Household surveys show consistent preference of private services for healthcare; reasons for this are based on subjective public perception.	Trust in public health services be enforced through SBCC events, reinforcing benefits of the intervention delivered via government systems.
Outer Setting: local conditions **Individuals (recipients):** opportunity	87% own two-wheelers, 38% cars, yet access constrained; 82.6% in joint families but low reported support.	**Terrain** and **transport gaps**; *"there isn't even a bus available here."* Childcare and lone-travel barriers for women.	While asset ownership suggested access, interviews showed that family ownership of private vehicles may not translate to access for women.	Decentralizing the care continuum from preconception to early childhood to the HWC-AAM level could enable women to complete visits.
Inner Setting: information technology infrastructure, access to knowledge & information	MCP card possession 63.3% (R1) → 91.9% (R3); fully completed cards 4.2% → 24%; HBNC entries absent.	**Card shortages, photocopied sheets**; **RCH portal entry blocked** by missing desktops; **paper preferred.** *"How will you keep one sheet for nine months?"*	Documentation is present in structure but not in functional use; qualitative examination shows several logistical gaps.	Documentation must be strengthened at all levels through retraining, positive supervision and planned inventory distribution.

Table 13: Joint display matrix for selected qualitative and quantitative findings with scale-up implications

Abbreviations

AAM: Ayushman Arogya Mandir

ANC: Antenatal care

ASHA: Accredited Social Health Activist

AWW: Anganwadi Worker

BIRAC: Biotechnology Industry Research Assistance Council

BMI: Body mass index

CFIR: Consolidated Framework for Implementation Research

CH: Civil Hospital

CHC: Community Health Centre

CHO: Community Health Officer

CI: Confidence interval

CTRI: Clinical Trials Registry of India

DOHaD: Developmental Origins of Health and Disease

FGD: Focus group discussion

HBNC: Home-Based Newborn Care

HBYC: Home-Based Young Child Care

HRP card: High-Risk Pregnancy card

HWC-AAM: Health and Wellness Centre – Ayushman Arogya Mandir

ICDS: Integrated Child Development Services

ICMR: Indian Council of Medical Research

IDI: In-depth interview

IFA: Iron and folic acid

KMC: Kangaroo Mother Care

LMIC: Low- and middle-income country

MAM: Moderate acute malnutrition

MCP card: Mother and Child Protection card

MO: Medical Officer

NFHS: National Family Health Survey

NITI Aayog: National Institution for Transforming India

PHC: Primary Health Centre

PMSMA: Pradhan Mantri Surakshit Matritva Abhiyan

PPP: Public–private partnership

RCH: Reproductive and Child Health

RH: Regional Hospital

SAM: Severe acute malnutrition

SBCC: Social and behaviour change communication

THR: Take-home ration

WaSH: Water, sanitation and hygiene

WINGS: Women and Infants iNtegrated interventions for Growth Study

Declarations:

Ethics approval and consent to participate: This study was conducted in accordance with the ethical principles of the World Medical Association Declaration of Helsinki (1964) and the Indian Council of Medical Research (ICMR) National Ethical Guidelines for Biomedical and Health Research Involving Human Participants (2017). Ethical approval for this study was granted by the Institutional Ethics Committee of the Society for Applied Studies (SAS/ERC/WINGS Scale up-HP/2023). National oversight for the project is provided by the Biotechnology Industry Research Assistance Council (BIRAC) (GCI-13012/3/2024-GCI). Administrative approvals were obtained from the Government of Himachal Pradesh through the State Departments of Health and Family Welfare and Women and Child Development (Memo No. Shimla-2/1June/2023/8483). Written informed consent was obtained from all participants prior to data collection.

Consent for publication: Not applicable. This manuscript does not include any individual's images, videos, or identifiable personal data. Verbatim quotations from interviews and focus group discussions are anonymised and cannot be attributed to identifiable individuals.

Availability of data and materials: The datasets used during the study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

SM and RS conceived the study. RS and BGP were involved in analysis, wrote the initial and subsequent drafts of the manuscripts. ASJ, DS, PK and SB coordinated the study at the site. ASJ, DS, SB were involved in data collection and MT, KT assisted in data collection and analysis. RS, SM and BGP provided input into the analysis, reviewed the preliminary results, and assisted in manuscript drafting. PKT, AC, RiK provided support in data collection and RC, ND, SuT, NB oversaw the project. SD, RG, GB, MD, SeT, SKV, SaM, AK, RaK provided necessary resources for the study and study oversight. All authors read, critically reviewed, and approved the final manuscript.

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MD: Mohan Dutt

SeT: Seema Thakur

SKV: Sanjiv Kumar Verma

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