Social and Behaviour Change Interventions to Improve Complementary Feeding Practices in Gujarat: A Mixed-Method Study

Abstract:
Background: Suboptimal complementary feeding (CF) practices remain a major contributor to child undernutrition in India, with limited evidence on the effectiveness of large-scale Social and Behaviour Change Communication (SBCC) interventions delivered through government systems. This study presents the first mixed-method, difference-in-differences (DiD) evaluation of an SBCC intervention implemented at scale through the Integrated Child Development Services (ICDS) in Gujarat, India.

Material and Methods: A quasi-experimental mixed-method design was used under Project Vruddhi, comparing Sabarkantha (intervention) and Aravalli (control) districts. Cross-sectional baseline (2021) and endline (2024) surveys were conducted among mothers of children aged 6–23 months (n = 3,174), alongside qualitative consultations with mothers, caregivers, and frontline workers. Primary outcomes included timely initiation of CF, minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD), and breastfeeding indicators.
Statistical analysis used: Difference-in-differences (DiD) evaluation

Results: Timely initiation of CF remained high in both districts, but gains were significantly greater in the control (DiD OR = 0.23; 95% CI: 0.14–0.38). MDD and MAD improved in the control (MDD: 39.3%→58.3%; MAD: 34.9%→52.1%) but declined in the intervention (MDD: 48.4%→40.0%; MAD: 40.5%→35.2%). The analysis of frontline worker (FLW) engagement showed higher visit coverage and complementary feeding (CF) day attendance in Aravalli at endline, suggesting stronger service delivery in the control area. Limited FLW contact and stagnant community participation in Sabarkantha may have constrained exposure to SBCC messages.

Conclusions: Despite implementation through ICDS platforms, the SBCC package did not improve CF practices. Findings highlight the need for stronger intervention fidelity, sustained FLW engagement, and community-driven delivery to achieve behaviour change at scale.

Key-words: complementary feeding; SBCC; mixed-method; difference-in-difference; India; routine programs
Key Messages: This mixed method DiD evaluation shows that SBCC interventions implemented through ICDS alone were insufficient to improve complementary feeding practices in Gujarat; gaps in frontline worker contact, intervention fidelity, and community participation critically limited behaviour change outcomes.

Introduction:

Malnutrition continues to be a leading contributor to morbidity and mortality among children under five globally, with India bearing nearly one-third of the world's burden of undernutrition (1). Despite recent improvements in some indicators, complementary feeding practices in India remain suboptimal: only 46% of infants aged 6-8 months receive complementary foods alongside breastmilk, and merely one in ten children between 6-23 months are fed according to WHO-recommended practices for dietary diversity and meal frequency (2-3).

Complementary feeding, defined as the introduction of solid, semi-solid, or soft foods alongside continued breastfeeding from six to 23 months, is critical to meet the evolving nutritional requirements of infants (4). The World Health Organization recommends timely initiation, adequate frequency of feeding, and dietary diversity across multiple food groups to support healthy growth and development (4).

There is substantial evidence that appropriate complementary feeding practices, including dietary diversity, meal frequency, and timely introduction of foods, reduce risks of stunting, wasting, and micronutrient deficiencies while also supporting cognitive development. Much of the global evidence comes from efficacy-oriented studies such as randomized controlled trials and pilot programs. Some Social and Behaviour Change (SBC) interventions in India have been tested at scale within government- led programs. These interventions, using peer counselling, group sessions, and community engagement, have shown improvements in multiple complementary feeding indicators (5).

While earlier studies have shown that social and behavior change interventions can improve infant and young child nutrition under efficacy-trial conditions, little is known about their performance when embedded within routine government systems. To address this evidence gap, the present study evaluates an SBC-integrated intervention delivered through existing ICDS and health platforms in Gujarat between 2021 and 2024, using a quasi-experimental design with difference-in-differences method complemented by qualitative insights.

The study objectives are to:

- Measure changes in key complementary feeding indicators over time; and
- Assess the effect of the SBC intervention relative to a control district using a difference-in- differences approach.
- Measure the impact of behavioral change strategies implemented at scale outside of a research setting, through the strengthening of government delivery platforms.

Material and Methods:

Study Design and Setting:

This study employed a quasi-experimental, mixed-method design as part of Project Vruddhi. The intervention was implemented in Sabarkantha district, Gujarat, with Aravalli serving as the control district. The evaluation included a cross-sectional baseline survey (August-September 2021), community consultations (November 2021-May 2022), and a follow-up endline survey conducted between October-December 2024; IEC Approval HERC/AAH/India/Oct/12/2024 reference Project Vruddhi.

The baseline and endline surveys followed a cross-sectional, multi-stage sampling strategy with both quantitative and qualitative components. The intervention district (Sabarkantha) received a structured Social and Behaviour Change Communication (SBCC) package, while the control district (Aravalli) continued with standard government services.

Study Population and Sampling

The broader Project Vruddhi targeted mothers of children aged 0-35 months, stratified into four age groups: 0-5 months, 6-11 months, 12-23 months, and 24-35 months. For the quantitative survey, 400 mothers were sampled per stratum per district per round, leading to a total of 3,200 per district (1,600 intervention and 1,600 control) and 6,400 across both districts at baseline and endline. Sampling was stratified by tribal and rural populations across all blocks, ensuring proportional representation from both geographies.

The sample size was determined using the formula for binomial proportions,

$$\frac{PxQxN}{(Nx0.05^2) \div (1.96^2 + PxQ)}$$

where *N* is the size of the eligible population, *P* represents coverage/burden, *Q = 1-P*, 1.96 is the z-score for the 95% confidence interval (CI), and 0.05 is the margin of error (±5%). Assuming a n α error of 0.05, β error of 0.2, and absolute precision of 5%, the most conservative sample size required for district- level estimates was 384 per age group. Accounting for an anticipated 5% sample loss, the target was set at 400 per age group per district.

For the present analysis, we focused specifically on mothers of children aged 6-23 months, corresponding to two of the four strata from the Project Vruddhi surveys. This subgroup aligns with the

complementary feeding window and is the population of interest for assessing SBCC intervention effects.
A total of 400 Anganwadi Centres (AWCs) were randomly selected per district, and one respondent from each of the four child age groups was recruited from each AWC using a systematic random household selection approach.
The qualitative component was conducted in three blocks of Sabarkantha, Idar (better performing), Vadali (poor performing), and Poshina (tribal), selected through pass-fail analysis of baseline indicators. From each block, two Gram Panchayats were purposively chosen to capture contextual diversity. Two AWCs were selected per Panchayat, and respondents included pregnant women, lactating women/caregivers of children aged 0-5 months, and mothers/caregivers of children aged 6-23 months. A purposive sampling strategy and the principle of data saturation were applied to finalize the number of in-depth interviews (IDIs) and focus group discussions (FGDs).

Data Collection and tools

The baseline and endline household surveys used structured, close-ended questionnaires administered via trained enumerators using digital data collection platforms.

Respondent selection followed a random start with systematic sampling using the AWC survey register. In each sampled AWC, one mother from each of the four target age groups was selected based on random interval sampling. Data collectors also interviewed the Accredited Social Health Activist (ASHA) and Anganwadi Workers (AWW) associated with the same AWC using structured tools, while semi-structured interviews were conducted with supervisory and programmatic stakeholders including Lady Supervisors (LS), Child Development Project Officers (CDPOs), and Medical Officers (MO- PHC).

Data for this study included both primary and secondary sources. Primary data were collected to assess CF indicators, specifically focusing on whether children aged 6-23 months met the WHO recommendation on CF. This information was gathered through structured interviews with participants. Additional variables such as maternal age, caste group, number of pregnancies, participation in community events (e.g., Godh Bharai), and counselling received from frontline health workers were also captured as part of the primary data collection.

Qualitative Component

The qualitative component of this study draws on data from the interim “Qualitative Deep Dive” conducted under Project Vruddhi in Sabarkantha district. As part of the broader evaluation, purposive sampling was used to select three blocks (Idar, Vadali, Poshina) to capture diverse contexts. In-depth

interviews (IDIs) and focus group discussions (FGDs) were carried out with pregnant women, lactating women, and caregivers of children aged 0-23 months, alongside frontline and supervisory health staff (AWWs, ASHAs, ANMs, Lady Supervisors, CDPOs, and Medical Officers). Data collection was undertaken by trained field researchers using semi-structured guides in the local language, with sampling continued until thematic saturation was achieved. Transcripts were thematically analysed by the Project Vruddhi research team, and findings were summarized in an interim report. For the purposes
of this manuscript, we relied on these synthesized themes and illustrative findings to complement the quantitative survey data; no new qualitative data collection or analysis was undertaken by the authors.

SBC Intervention Package

The SBC intervention package under Project Vruddhi was designed through a rigorous process grounded in evidence and community voice. It drew upon findings from a comprehensive baseline survey and in- depth qualitative consultations across all rural and tribal blocks of intervention (Sabarkantha) district. These inputs informed a targeted SBC strategy addressing key behaviours among pregnant and lactating women, such as delayed pregnancy registration, poor ANC service utilization, low dietary diversity, and poor compliance with IFA supplementation as well as systemic issues like weak counselling skills and lack of convergence among frontline health workers and supervisors.

A pilot intervention was rolled out between June and December 2022 in 45 Anganwadi Centres (AWCs) across 8 blocks of intervention district. The pilot focused on training health and Integrated Child Development Services (ICDS) supervisors in maternal, infant and young children nutrition (MIYCN), and strengthening front line workers (FLW) capacities through joint home visits, and supportive supervision. Over 270 mothers' meetings were conducted, complemented by home visits and community-based IPC using existing and co-developed Education and Communication (IEC) materials. Results from the pilot confirmed the feasibility and relevance of the approach. The model emphasized a multi-tier communication strategy targeting individual beneficiaries, families, community influencers, and frontline functionaries through home visits, Audio-Visual (AV) aids, social media, folk performances, and peer-led platforms.

The primary outcomes were:

1. Timely initiation of complementary feeding: Proportion of children 6-8 months who received solid, semi-solid, or soft foods.
2. Minimum Dietary Diversity (MDD): Proportion of children 6-23 months who consumed foods from ≥ 5 out of 8 food groups.

3. Minimum Meal Frequency (MMF): Proportion of children 6-23 months who received the minimum recommended number of feeds during the previous day.

4. Minimum Acceptable Diet (MAD): Proportion of children 6-23 months who received both minimum dietary diversity and minimum meal frequency.

5. Breastfeeding status: Proportion of children currently breastfed (with exclusive breastfeeding for infants under 6 months assessed where relevant).

Data Analysis

Descriptive statistics were used to summarize sociodemographic characteristics and primary outcome indicators, including CF indicators such as timely initiation of CF; Minimum Dietary Diversity (MDD); Minimum Meal Frequency (MMF); Minimum Acceptable Diet (MAD); and breastfeeding indicators such as currently breastfeeding and never breastfed. The threshold for timely initiation of CF reflects the WHO recommendation, where the introduction of solid, semi-solid, or soft foods is classified as too early if given before 6 months (<180 days), timely if introduced at 6-8 months (180-269 days), and too late if introduced after 8 months (≥270 days). Descriptive analysis was also conducted to examine exposure to front-line workers, including the frequency of Anganwadi Worker (AWW) visits and mothers' attendance at complementary feeding (CF) day events, at baseline and endline.

MDD was defined using the WHO recommendation of consuming at least 5 out of 8 food groups in the previous 24 hours, although a cut-off of 4 out of 8 food groups was also explored. Similarly, MMF was defined according to the WHO thresholds as receiving solid, semi-solid, or soft foods (including milk feeds for non-breastfed children) at least 2 times for breastfed infants 6-8 months, at least 3 times for breastfed children 9-23 months, and at least 4 times for non-breastfed children 6-23 months in the previous 24 hours. Finally, MAD was calculated as the proportion of children meeting both the MDD and MMF criteria, with additional inclusion of at least two milk feeds for non-breastfed children as per WHO recommendations. These indicators were compared between baseline and end line using proportions for categorical variables and means or medians for continuous variables.

Difference-in-Differences (DiD) analyses were conducted to estimate the additional effect of the SBC intervention on changes in CF-related indicators over time. More specifically, the DiD analyses assessed whether the change over time differs between groups using the following formula: $Outcome = \beta 0 + \beta 1 \cdot time + \beta 2 \cdot intervention_arm + \beta 3 \cdot (time \times intervention_arm)$.

Separate DiD models were developed for the following outcomes: TICF; MDD; MMF; MAD; BF.
All statistical analyses were conducted using RStudio. Results were interpreted using probabilistic language, based on the strength of the evidence, rather than solely on p-value thresholds.
Statistical coding was validated with AI-assisted tools

Results:

Sample population characteristics

The analysis focused on a total of 3,174 mothers of children aged 6-23 months, including 1,576 mothers from the baseline survey (786 control and 790 intervention) and 1,598 from the endline survey (782 control and 816 intervention). Nearly all participants identified as Hindu (>95% across all groups). A small proportion identified as Muslim (1-5%), with higher representation in the intervention groups at both baseline and endline, and very few reported belonging to other religions.

The sample included women from a range of caste groups. At baseline, the most represented caste category was Other Backward Classes (OBC), comprising 43.6% of the control group and 36.5% of the intervention group. These proportions remained high at endline (44.4% and 43.5%, respectively). Scheduled Tribe and Scheduled Caste groups were also well represented, while the General category ranged from 8.3% to 13.3% across rounds and groups (Table 1). Literacy was high across both districts and survey rounds, with more than three-quarters of mothers able to read and write (76-89%) (Table 1).

Descriptive analysis: Front-line workers visits & CF day attendance

At baseline, 67.3% of mothers in Aravalli and 70.9% in Sabarkantha reported receiving at least one visit from an Anganwadi Worker (AWW). At endline, the proportion of reported visits remained similar (69.2% in Aravalli and 67.2% in Sabarkantha). Among those visited, the majority of mothers reported receiving two visits during the recall period (43.8% in Aravalli and 31.1% in Sabarkantha at baseline; 43.7% and 38.6%, respectively, at endline). Around one-quarter reported one visit (21.7–24.5% at baseline; 22.8–38.6% at endline), and fewer than 7% reported receiving more than four visits across both districts and survey rounds (Table 2).

Attendance at complementary feeding (CF) day events showed a modest increase over time. At baseline, 31.1% of mothers in Aravalli and 38.3% in Sabarkantha reported attending a CF day, rising to 43.9% and 33.7%, respectively, at endline. Most mothers did not attend these events (52–64%), while a small proportion reported that they did not remember (3–10%) (Table 2).

Descriptive analysis: IYCF indicators

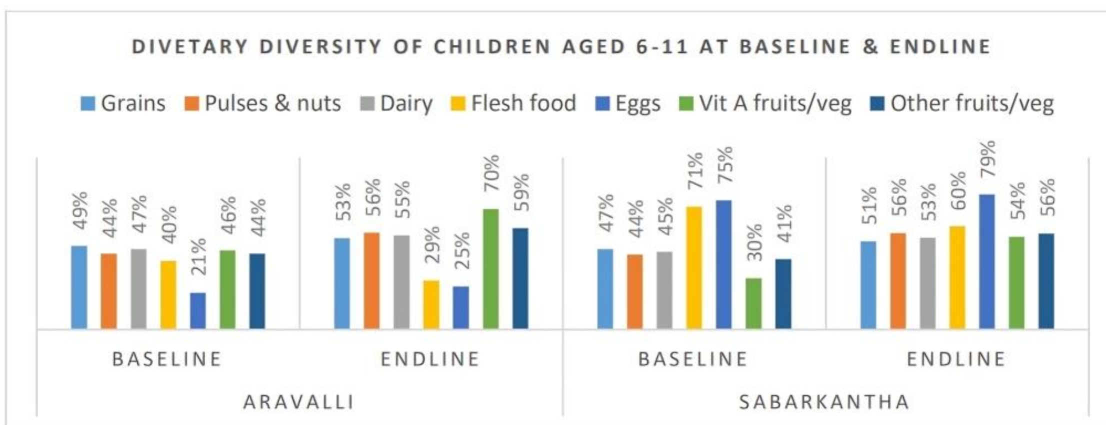
At baseline, timely initiation of complementary feeding was reported for 79.5% of children in Aravalli and 88.1% in Sabarkantha. By endline, timely initiation had increased to 94.6% in Aravalli, while it remained stable in Sabarkantha (88.4%). Early initiation decreased from 8.4% to 2.5% in Aravalli and

remained stable (2.3% to 2.9%) in Sabarkantha, while late initiation declined from 12.1% to 2.9% in Aravalli and from 9.6% to 8.7% in Sabarkantha (Table 3).
Minimum dietary diversity showed improvements in Aravalli, where the proportion of children meeting the WHO threshold of five or more food groups increased from 39.3% at baseline to 58.3% at endline, and the median MDD score rose from 4 [3-5] to 5 [4-6]. In contrast, in Sabarkantha the proportion meeting MDD declined from 48.4% at baseline to 40.0% at endline, with the median score remaining unchanged at 4 [3-5]. The proportion not meeting the threshold decreased in Aravalli (60.7% to 41.7%) but increased in Sabarkantha (51.6% to 60.0%) (Table 3).
Meal frequency remained consistently high across both districts. In Aravalli, 90.2% of children met MMF at baseline and 94.2% at endline. In Sabarkantha, the figures were 93.4% at baseline and 92.3% at end line.
Minimum acceptable diet improved in Aravalli, where the proportion of children meeting MAD increased from 34.9% at baseline to 52.1% at endline. In Sabarkantha, however, MAD declined from 40.5% to 35.2% over the same period. The proportion not meeting MAD decreased from 65.1% to 47.9% in Aravalli but increased from 59.5% to 64.8% in Sabarkantha (Table 3).

Breastfeeding rates remained high and stable throughout the study period. At baseline, 90.6% of children in Aravalli and 88.4% in Sabarkantha were breastfed, compared to 92.3% and 88.5% respectively at endline (Table 3).

Figures 1 and 2 below present the proportion of children consuming different food groups at baseline and endline, disaggregated by age group and district.

Figure 1. Dietary diversity of children aged 6-11 months

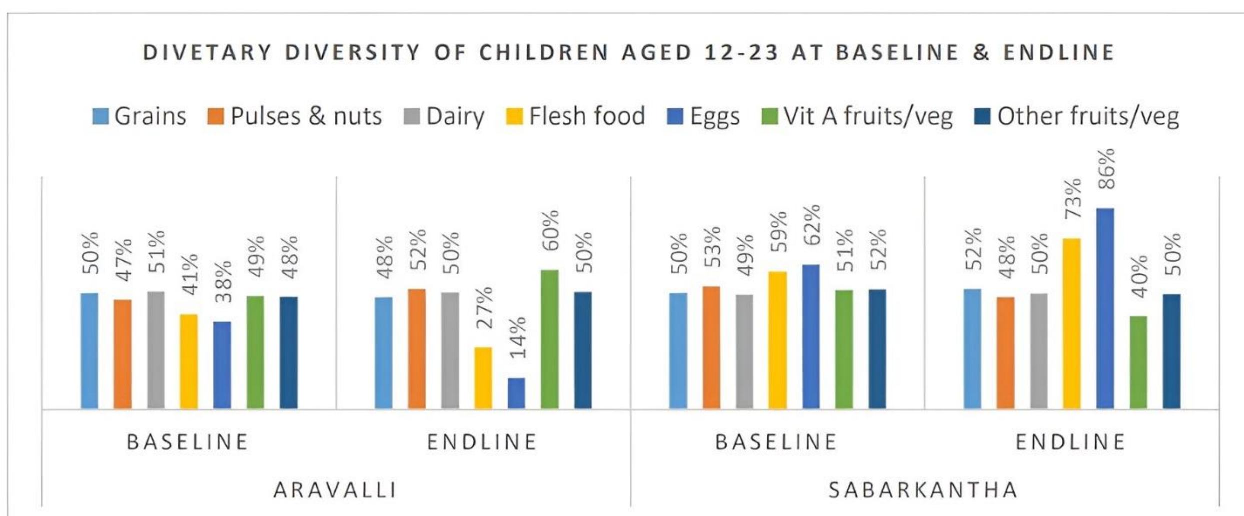


Beyond composite indicators, analysis of individual food groups showed that in Aravalli, consumption

of grains, pulses and nuts, and dairy was relatively stable across survey rounds, while modest increases were observed in vitamin A-rich fruits and vegetables (6-11 months: 46% to 70%; 12-23 months: 49%

to 60%) and other fruits and vegetables (6-11 months: 44% to 59%). Intake of flesh foods decreased among both younger (40% to 29%) and older children (41% to 27%), and egg consumption remained low (6-11 months: 21% to 25%; 12-23 months: 38% to 14%)
In Sabarkantha, consumption of grains, pulses and nuts, and dairy remained broadly similar between baseline and endline. Among children aged 6-11 months, intake of flesh foods decreased (71% to 60%), while egg consumption remained very high (75% to 79%). At the same time, vitamin A-rich fruits and vegetables (30% to 54%) and other fruits and vegetables (41% to 56%) increased. Among children aged 12-23 months, consumption of flesh foods (59% to 73%) and eggs (62% to 86%) increased, whereas intake of vitamin A-rich fruits and vegetables declined (51% to 40%) and other fruits and vegetables remained unchanged (52% to 50%).

Figure 2. Dietary diversity of children aged 12-23 months



Difference-in-Difference

For timely initiation of complementary feeding, regression analyses indicated that at baseline in the control district (Aravalli), the odds of timely initiation were nearly four times higher compared to not initiating on time (OR = 3.89, 95% CI: 3.21-4.75, p<0.0001). Children in the intervention district (Sabarkantha) had significantly higher odds of timely initiation at baseline relative to the control (OR = 1.90, 95% CI: 1.40-2.59, p=0.000039). By endline, the odds of timely initiation in the control district had further increased more than fourfold compared to baseline (OR = 4.52, 95% CI: 3.09-6.79, p<0.0001). However, the difference-in-difference estimate showed that the increase over time was significantly smaller in the intervention district than in the control (OR = 0.23, 95% CI: 0.14-0.38, p<0.0001) (Table 3).

At baseline in the control district of Aravalli, the odds of meeting minimum dietary diversity were 0.65 times the odds of not meeting it (OR=0.65, 95% CI: 0.56-0.75, p<0.001), while children in Sabarkantha

had higher odds of meeting MDD compared to control (OR=1.45, 95% CI: 1.18-1.77, p=0.0003). In Aravalli, the odds of meeting MDD improved at endline compared to baseline (OR=2.16, 95% CI: 1.77- 2.64, p<0.001). However, the difference-in-difference effect indicated that the increase over time was significantly smaller in Sabarkantha compared to Aravalli (OR=0.33, 95% CI: 0.25-0.44, p<0.001).
For minimum meal frequency, the odds of meeting MMF were already high in Aravalli at baseline (OR=9.24, 95% CI: 7.24-11.99, p<0.001), with Sabarkantha children showing higher odds relative to Aravalli (OR=1.54, 95% CI: 1.04-2.29, p=0.031). The odds of meeting MMF in Aravalli increased further at endline (OR=1.75, 95% CI: 1.18-2.62, p=0.006), but the difference-in-difference effect revealed that the increase was smaller in Sabarkantha compared to Aravalli (OR=0.48, 95% CI: 0.27- 0.84, p=0.011).

For minimum acceptable diet, the odds of meeting MAD were low in Aravalli at baseline (OR=0.54, 95% CI: 0.46-0.62, p<0.001), while children in Sabarkantha had higher odds compared to control (OR=1.27, 95% CI: 1.04-1.56, p=0.021). The odds of meeting MAD in Aravalli more than doubled at endline (OR=2.03, 95% CI: 1.66-2.49, p<0.001), but the difference-in-difference analysis showed that the increase was significantly smaller in Sabarkantha compared to Aravalli (OR=0.39, 95% CI: 0.30- 0.52, p<0.001).
Finally, breastfeeding rates were already high in Aravalli at baseline (OR=9.62, 95% CI: 7.63-12.32, p<0.001), and no significant baseline differences were observed between districts (OR=0.79, 95% CI: 0.57-1.09, p=0.150). No meaningful changes over time were observed in Aravalli (OR=1.25, 95% CI: 0.88-1.79, p=0.218), and the difference-in-difference analysis confirmed no significant differences in breastfeeding trends between Sabarkantha and Aravalli (OR=0.81, 95% CI: 0.51-1.29, p=0.377).

Community consultations

In Sabarkantha, breastfeeding and complementary feeding practices were shaped by a mix of cultural beliefs, family influence, health system gaps, and household circumstances.
Complementary feeding practices varied considerably. Early initiation before six months occurred in some cases, particularly when mothers returned to work or on advice of neighbours or relatives. Delayed initiation beyond 7-9 months was also observed, commonly linked to the cultural belief in gadu padna (a condition believed to be caused by early semi-solid feeding). Foods used for initiation included tea with milk, biscuits, khichdi water, rice water, raab, moong dal water, mashed roti with milk, cerelac, and fruit juice. Ghee and green leafy vegetables were generally avoided, believed to be sticky, difficult to digest, or suitable only for older children. Non-vegetarian foods were widely restricted due to socio- religious norms, with negligible weekly consumption.

Dietary diversity among 6-23-month-old children was poor. Most diets lacked pulses, fats, and green leafy vegetables, and were dominated by cereals, biscuits, tea, and packaged snacks. Some mothers reported feeding fruits like apple, guava, and banana, often in mashed form or via fruit feeders in better-off households. Feeding frequency was often adequate (2-4 meals daily), but amounts given were typically very small compared to recommended age-appropriate portions.

For children 12-23 months, foods were usually taken from the family pot, including rice, roti, dal, khichdi, and vegetables. However, quantity remained limited (often a teaspoon to a tablespoon), and packaged foods such as biscuits, gathiya, sev, and puffed rice were commonly used, especially when caregivers were away for farm work. Some mothers reported spending daily cash on packaged snacks to appease children. Vegetables and pulses were provided when available from kitchen gardens or local markets, but affordability constrained regular use.

Engagement with Anganwadi centers was minimal. Very few mothers had attended Annaprashan ceremonies or received systematic counselling on complementary feeding from AWWs. Most reported not being informed of or invited for demonstration sessions, while some recalled receiving only sporadic advice over the phone.

Breastfeeding counselling was inconsistent. Some mothers reported visits from ASHAs, ANMs, or UNICEF counsellors who provided advice on diet, positioning, or skin-to-skin contact. However, many also relied on family members such as mothers-in-law or sisters-in-law for guidance. Breast-feeding frequency was largely demand-driven, with mothers feeding when the baby cried or showed discomfort. Most described feeding episodes lasting 5-15 minutes, though observations suggested actual feeding times were often shorter. Awareness of hunger cues and sufficiency of breastmilk was limited.

Discussion:

This study assessed the effect of a SBCC intervention on complementary feeding practices in Sabarkantha district compared to Aravalli as a control. Overall, the quantitative results indicated that improvements in key complementary feeding indicators were observed more prominently in the control district. Timely initiation of complementary feeding remained high in both districts, but the increase over time was significantly greater in the control area than in the intervention. Minimum dietary diversity improved in the control district but declined in the intervention district, while meal frequency was consistently high across both sites, with only modest gains in the control district. Similarly, minimum acceptable diet improved in the control district but showed a decline in the intervention. Breastfeeding indicators, already at high levels at baseline, remained largely unchanged over time. Beyond summary indicators, the analysis of individual food groups showed that consumption of grains, pulses, and dairy remained consistently high in both districts, while limited changes were observed in fruits and vegetables. In Sabarkantha, increases were noted in animal-source foods, particularly eggs and flesh foods, whereas in Aravalli some gains were observed in vitamin A-rich fruits and vegetables. These shifts, however, were not sufficient to translate into improvements in minimum dietary diversity overall.

The qualitative findings, conducted at baseline in Sabarkantha, provide useful insights into prevailing complementary feeding practices. Mothers described diets dominated by cereals and packaged snacks, with limited use of pulses, vegetables, and animal-source foods. This is broadly consistent with the low consumption of fruits and vegetables reported quantitatively at baseline, but contrasts with the high levels of egg and flesh food consumption observed in the survey data. At endline, the quantitative results indicated further increases in animal-source foods among older children and gains in vitamin A-rich fruit and vegetable intake among younger children, suggesting some shifts in feeding practices over time. However, these improvements did not translate into overall gains in minimum dietary diversity. The divergence between qualitative and quantitative findings may reflect differences in maternal perceptions of diet compared to reported recall of specific foods, or variation in practices across households that was not fully captured in the qualitative sample.

Cultural beliefs, household influences, and food availability further shaped these practices. For example, delayed introduction of semi-solid foods due to perceptions of gadu padna, restrictions on green leafy vegetables and ghee for younger children, and limited inclusion of non-vegetarian foods were commonly reported. Affordability and accessibility also constrained dietary diversity, with families often resorting to biscuits or tea as substitutes for more nutrient-dense foods. Together, these factors reinforce the survey findings that behavior change practices require a bottom-up approach from the community and targeting health workers is not sufficient.

Additional analysis of FLW engagement provides further insight into these findings. At baseline, a higher proportion of mothers in Sabarkantha reported receiving AWW visits compared to Aravalli. However, this pattern reversed at endline, with coverage of AWW visits increasing in Aravalli while remaining largely stagnant in Sabarkantha. Moreover, mothers in Aravalli consistently reported a greater number of visits than those in Sabarkantha at both time points, suggesting stronger and more sustained FLW engagement in the control area. A similar trend was observed for complementary feeding (CF) day participation, which increased in Aravalli but not in Sabarkantha. These patterns indicate that the intended intensification of SBCC delivery through FLWs may not have materialized in the intervention district. The limited increase in FLW contact and low community event participation in Sabarkantha could therefore help explain the absence of improvements in complementary feeding indicators despite the planned intervention. In contrast, the unexpected gains in the control district may reflect stronger program implementation by FLWs or concurrent government and community efforts independent of the project.

This study has several limitations. First, outcomes relied on maternal recall of feeding practices within the previous 24 hours, which may be subject to reporting and social desirability bias. Second, the qualitative findings used in this manuscript were drawn from secondary analysis of the interim Project Vruddhi report; as such, we were unable to re-examine raw transcripts or explore additional themes beyond those synthesized in the original analysis. Finally, external factors not captured in the study, including changes in food availability, seasonality, or concurrent government initiatives, may also have contributed to changes observed in the control and intervention districts.

Findings from our study are consistent with evidence from a previous narrative review on complementary feeding practices through peer counselling interventions in Asian and African contexts. In our study, the SBCC package was implemented at scale through existing government systems, relying
on frontline workers with multiple responsibilities and variable engagement with beneficiaries. Recent syntheses across multiple LMICs show that effects are heterogeneous and depend strongly on exposure, fidelity, and delivery intensity, and that inequalities in complementary feeding practices can persist following large-scale program implementation (6).

In contrast, the narrative review of six studies, including randomized and quasi-experimental designs, reported positive effects of peer counselling on timely initiation of complementary feeding, dietary diversity, and breastfeeding, often delivered in programmatic or research-driven settings with close supervision and dedicated peer facilitators (7). Comparable improvements in complementary feeding indicators have been documented in Ethiopia, where community-based behaviour change communication improved timely introduction of complementary foods and dietary adequacy (8-9), and in Nigeria, where engaging both mothers and fathers increased fish and egg consumption as well as

minimum meal frequency (10). Evidence from India also reinforces the value of community-based platforms: an evaluation of the JEEViKA program in Bihar found that integrating behavior change communication into women's self-help group meetings was associated with significant improvements in child dietary diversity, demonstrating the potential of peer-group approaches to complement health worker-led delivery (11).

Further, a quasi-experimental study in peri-urban Chandigarh showed that culturally tailored nutrition education delivered through health workers, combined with digital growth monitoring, improved complementary feeding practices, weight and length gain, and reduced wasting among infants (12). Evidence from at-scale programmatic platforms such as Alive & Thrive in Bangladesh and Ethiopia demonstrated that well-designed and well-implemented at-scale interventions, combining interpersonal counselling, community mobilization, advocacy, mass communication, and strategic use of data, can improve IYCF practices rapidly when grounded in formative research and adapted to local contexts with strong involvement of mothers, family members, community influencers, and policymakers (13-14). These findings suggest that engaging communities is as important as strengthening delivery systems when designing complementary feeding interventions.

Effective behaviour change requires a bottom-up, community-driven approach; focusing solely on health workers is not sufficient.

Conclusions:

This mixed-method evaluation of an at-scale SBCC intervention delivered through routine ICDS systems in Gujarat demonstrates that strengthening complementary feeding practices requires more than the provision of communication tools and training sessions for frontline workers. Despite the structured intervention, complementary feeding indicators did not improve in the intervention district, while the control area showed notable gains in dietary diversity, minimum acceptable diet, and timely initiation
of feeding. Qualitative insights highlight persistent cultural beliefs, familial influences, affordability constraints, and limited exposure to frontline counselling shaped feeding behaviours and may have restricted the uptake of SBCC messages in Sabarkantha.

The findings underscore that intervention fidelity, sustained FLW engagement, and meaningful community participation are essential for behaviour change at scale. Strengthening delivery platforms without ensuring regular and supportive contact between families and frontline workers may not yield the intended improvements in IYCF practices. Future programs should prioritize bottom-up, community-driven SBCC approaches, involve families and influential community actors, and embed mechanisms to monitor delivery intensity. Integrating these elements into routine systems may help translate SBCC strategies into measurable improvements in complementary feeding and child nutrition outcomes.

Limitations:
This study has several limitations that should be considered when interpreting the findings. First, the quasi-experimental, cross-sectional baseline endline design limits causal inference and observed changes cannot be attributed solely to the SBCC intervention. Second, complementary feeding practices were assessed using maternal 24-hour recall, which is subject to recall and social desirability bias. Third, while difference-in-differences analysis helps account for time-invariant confounding, unmeasured contextual factors such as concurrent government initiatives, variations in frontline worker deployment, seasonality, or local food availability may have influenced trends, particularly in the control district.

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Table 1. Overview of study sample

Sociodemographic profile of respondents

		Baseline (C)	Baseline (I)	Endline (C)	Endline (I)
Characteristic	**Categories**	**n = 786**	n = 790	n = 782	n = 816
		n (%)	n (%)	n (%)	n (%)
Religion	Hindu	770 (98.0%)	751 (95.1%)	775 (99.1%)	791 (96.9%)
	Islam	11 (1.4%)	37 (4.7%)	6 (0.8%)	23 (2.8%)
	Other	2 (0.3%)	2 (0.3%)	0 (0.0%)	0 (0.0%)
Caste	Scheduled Caste	161 (20.5%)	128 (16.2%)	104 (13.3%)	94 (11.5%)
	Scheduled Tribe	217 (27.6%)	269 (34.1%)	230 (29.4%)	260 (31.9%)
	OBC	343 (43.6%)	288 (36.5%)	347 (44.4%)	355 (43.5%)
	General category	65 (8.3%)	105 (13.3%)	101 (12.9%)	107 (13.1%)
Literacy	Yes	645 (82.1%)	603 (76.3%)	694 (88.7%)	671 (82.2%)
	No	141 (17.9%)	187 (23.7%)	88 (11.3%)	145 (17.8%)

Table 2. Overview of Front-line workers' visits & CF day attendance

Variable	Categories	Baseline: Aravalli n (%)	Baseline: Sabarkantha n (%)	Endline: Aravalli n (%)	Endline: Sabarkantha n (%)
Front-line workers' visit	Yes	264 (67.3)	278 (70.9)	274 (69.2)	272 (67.2)
	No	125 (32.1)	114 (20.1)	119 (30.1)	132 (32.8)
Number of FLWs' visits	1	54 (21.7)	65 (24.5)	58 (22.8)	97 (38.6)
	2	109 (43.8)	80 (31.1)	111 (43.7)	97 (38.6)
	3	57 (22.9)	69 (26.8)	63 (24.8)	34 (13.5)
	4	15 (6.0)	28 (10.9)	11 (4.3)	7 (2.8)
	≥5	14 (5.6)	17 (6.7)	11 (4.4)	16 (6.4)
Attendance to CF day	Yes	122 (31.1)	150 (38.3)	174 (43.9)	136 (33.7)
	No	251 (64.0)	204 (52.0)	210 (53.0)	238 (59.1)
	Don't remember	19 (4.8)	38 (9.7)	12 (3.0)	29 (7.2)

Table 3. Descriptive statistics: Complementary Feeding indicators

Indicator	Aravalli		Sabarkantha	
	Baseline	Endline	Baseline	Endline
Timely initiation of CF	494/621 (79.5%)	616/651 (94.6%)	577/655 (88.1%)	602/681 (88.4%)
Early initiation of CF	52/621 (8.4%)	16/651 (2.5%)	15/655 (2.3%)	20/681 (2.9%)
Late initiation of CF	75/621 (12.1%)	19/651 (2.9%)	63/655 (9.6%)	59/681 (8.7%)
MDD≥5 food groups	309/786 (39.3%)	456/782 (58.3%)	382/790 (48.4%)	326/816 (40.0%)
MMF met	619/686 (90.2%)	696/739 (94.2%)	654/700 (93.4%)	681/738 (92.3%)
MAD met	272/780 (34.9%)	406/780 (52.1%)	317/782 (40.5%)	286/812 (35.2%)
Currently breastfeeding	712/786 (90.6%)	722/782 (92.3%)	698/790 (88.4%)	722/816 (88.5%)

Table 4. Difference-in-difference by CF indicator

Variables	OR	95% CI	p-value
Timely initiation to Complementary Feeding			
Intercept	3.89	3.21-4.75	<0.0001
Group (interventionvs control)	1.9	1.40-2.59	0.000039
Time (endline vs baseline)	4.52	3.09-6.79	<0.0001
Group×Time (DiD effect)	0.23	0.14-0.38	<0.0001
Minimum Dietary Diversity			
Intercept	0.65	0.56-0.75	<0.001
Group (interventionvs control)	1.45	1.18-1.77	0.0003
Time (endline vs baseline)	2.16	1.77-2.64	<0.001
Group×Time (DiD effect)	0.33	0.25-0.44	<0.001
Minimum Meal Frequency			
Intercept	9.24	7.24-11.99	<0.001
Group (interventionvs control)	1.54	1.04-2.29	0.031
Time (endline vs baseline)	1.75	1.18-2.62	0.006
Group×Time (DiD effect)	0.48	0.27-0.84	0.011
Minimum Acceptable Diet			
Intercept	0.54	0.46-0.62	<0.001
Group (interventionvs control)	1.27	1.04-1.56	0.02
Time (endline vs baseline)	2.03	1.66-2.49	<0.001
Group×Time (DiD effect)	0.39	0.30-0.52	<0.001\
Currently Breastfeeding			
Intercept	9.62	7.63-12.32	<0.001
Group (interventionvs control)	0.79	0.57-1.09	0.15
Time (endline vs baseline)	1.25	0.88-1.79	0.218
Group×Time (DiD effect)	0.81	0.51-1.29	0.377

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