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Maternal Health Decision-making in Multigenerational Households: Evidence from Field Experiments in India

by

Pooja Suri

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Health Policy

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor William H. Dow, Chair
Professor Edward A. Miguel
Professor Arun G. Chandrasekhar
Professor Lia H. Fernald

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Abstract

Maternal Health Decision-making in Multigenerational Households: Evidence from Field Experiments in India

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Doctor of Philosophy in Health Policy

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In low-and middle-income countries (LMICs), women often struggle to access health services through the perinatal period. In addition to supply-side geographical access and financial barriers, in many settings there are also constraints arising from a combination of complex family structures, low female agency, social norms, and a lack of information on the importance of seeking timely care. This combination of factors makes it challenging for policymakers to improve maternal and infant health, as typical policies focus on the supply-side, i.e. reducing cost of care, and improving accessibility. This dissertation presents results from three empirical studies conducted in India on the role of household members in decision-making in accessing perinatal care.

The first paper examines the dynamics between new mothers and their caregivers (spouse, mother, and mother-in-law) in making caregiving decisions for postnatal maternal and infant care. The second paper uses a randomized controlled trial to investigate the impact of targeted health messaging and social learning on antenatal care visits and iron and folic acid tablet consumption among pregnant women co-residing with their mothers-in-law. The third paper uses a cluster randomized trial to evaluate the effectiveness of a mobile messaging service delivering postnatal care information to households, and its impact on maternal and infant health outcomes.

In the first paper, I find that birthing women are more likely to name their caregivers (rather than themselves) as sole decision-makers for infant and maternal care, though agreement between the mother and caregiver on who is the decision-maker is low. I also find that the identity of the primary caregiver significantly affects maternal mental well-being, with lower well-being when the primary caregiver is their mother-in-law. The second paper demonstrates that involving mothers-in-law in a health messaging education intervention increases health-seeking behaviors and improves post-delivery outcomes. In the third paper,

I find that a mobile messaging service delivering postnatal care information to the entire household has a positive impact on maternal and infant health outcomes.

Collectively, these papers highlight the importance of considering the influence of family members, particularly the mother-in-law, in designing effective health interventions in LMICs. However, further research is needed to understand the factors that influence behaviors and to develop ways to address and modify strongly held priors and social norms that may hinder health-seeking behaviors. Additionally, this research focuses on the perinatal period, but future avenues of research can explore how this dynamic affects other health behaviors such as family planning and childhood nutrition, as well as resulting morbidity.

To the parts that make this life whole: Agastya Skanda-Suri, Skanda, and the Suris

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Chapter 1

Introduction

The focus of research in economics on intra-household health decision-making has largely been on spouses. However, in many low- and middle-income countries (LMICs), complex family structures—such as multi-generational households (Flores and Kalwij (2014); Khalil and Mookerjee (2019); Lee and Bauer (2013), polygamous families (Rossi (2019)), and those with strong matriarchal figures like the mother-in-law—significantly influence health outcomes (Anukriti et al. (2019, 2022); Ghosh and Thornton (2024); Khanna and Pandey (2020)). Interventions that target only women or couples may fail since they ignore the authority and status of other household members, especially when household preferences and incentives are misaligned (Ghosh and Thornton (2024)).

Patrilocality, a traditional system in which women live with their in-laws after marriage, is common among families in LMICs (Khalil and Mookerjee (2019)). Such a family arrangement plays a vital role in providing care for children and the elderly, perinatal support, enhancing labor force participation among younger members, and maintaining financial stability (Barr et al. (2012); Cox and Fafchamps (2007); Shorrocks (1979)). The wife's mother-in-law plays an outsized role in household management and decision-making within this family structure.

Recent descriptive and quasi-experimental studies show that co-residence can play out in opposing ways. The presence of the mother-in-law in the household can enhance labor force participation(Khanna and Pandey (2020)) and decrease the risk of iron-deficient anemia (Varghese and Roy (2019)). Positive daughter-in-law and mother-in-law relationships lead to more antenatal care visits and better postnatal mental health (Allendorf (2010); Chandran et al. (2002); Gausia et al. (2009)). However, there is evidence that also suggests that co-residence with in-laws, particularly the mother-in-law, can diminish a woman's authority in making her own health or labor participation decisions (Anukriti et al. (2019); Banerji et al. (2023); Ghosh and Thornton (2024)).

LMICs, particularly India, bear a greater burden of maternal and infant mortality and morbidity (WHO (2024)). In recent years, despite significant policy efforts in India, maternal and infant mortality rates have remained high (NFHS (2016a)). Most maternal and infant deaths are preventable with adequate care (Gupta et al. (2010); Kassebaum et al. (2016); Meh et al. (2022); Montgomery et al. (2014); Peña-Rosas et al. (2015)). However, the perinatal

period in India is characterized by limited access to health information and cultural norms that lead pregnant women and new mothers to rely heavily on others, particularly their mothers or mothers-in-law, for health decision-making and care practices (Choudhry (1997); Withers et al. (2018)). Additionally, a vast body of research in economics has shown that information, who it is given to, and whether it is provided in the presence or absence of peers can also significantly impact health outcomes (Bursztyn et al. (2019, 2018); Dupas (2011); Karing (2019)).

Consequently, this dissertation presents results from three empirical studies in India, focusing on the barriers to seeking care and examining how the provision of simple information and the involvement of household members affect perinatal health outcomes.

Chapter 2 examines the dynamics between new mothers and family members —specifically, their spouse, mother, and mother-in-law —in making caregiving decisions for postpartum maternal and infant care. The post-natal period is a critical time for the physical and mental recovery of the mother, as well as the development of the newborn, and a significant portion of infant deaths occur in the weeks following birth. Previous studies have linked the involvement of family members to improved maternal mental health, maternal-infant bonding, and increased breastfeeding. However, the specific influence of the mother and mother-in-law on health outcomes for both mothers and newborns remains poorly understood, especially in a unique cultural context like India where women have limited agency and rely heavily on caregivers for health information. Potential discordance between caregivers and mothers adds complexity to this dynamic.

Using data collected by Noora Health from 551 dyads of women with infants under six months and their primary family caregivers across four Indian states, I present descriptive statistics on: 1) the identity of the primary decision-maker as reported independently by new mothers and caregivers, and 2) how disagreements are resolved. I analyze agreement levels on maternal and infant health decision-making within each dyad, as well as the primary decision-maker.

I find that women are more likely to name their caregivers (rather than themselves) as the sole decision-makers for both infant and maternal care. Less than a third of women report involvement in household decision-making. Agreement on the identity of sole decision-makers was low, with less than a third of dyads in agreement for both infant and maternal care decisions. I also find that the identity of the primary caregiver significantly affects maternal mental well-being. Women report higher mental well-being (by 0.12 standard deviations of a normalized index) when their mother is the primary caregiver, compared to the spouse. In contrast, their mental well-being is negatively impacted (by 0.12 standard deviations) when their mother-in-law is the primary caregiver compared to the spouse. The type of caregiver also significantly affects post-delivery health.

Chapter 3 shifts focus to the prenatal period and investigates the impact of differentiated health messaging and social learning on antenatal care visits (ANC) and iron and folic acid (IFA) tablet consumption for pregnant women co-residing with their mothers-in-law.

High maternal mortality rates, especially in rural areas, remain a critical policy issue in India. Despite the availability of free antenatal care, ANC visits in India are low. Com-

mon factors include limited involvement of pregnant women in household decision-making, restrictions on traveling unaccompanied to health clinics, and families undervaluing prenatal care (Ogbo et al. (2019)). Given India's patrilocal society, it is important to understand how household members, especially mothers-in-law, influence young women's health, mobility, and resource decisions.

Along with collaborators, I conducted a randomized trial across 2409 households in 309 villages in India. We varied whether health information on ANC visits and IFA tablet consumption was given only to the daughter-in-law (pregnant woman) (DIL treatment) or to both the daughter-in-law and the mother-in-law (DIL+MIL treatment). I also varied information delivery at a group level with and without mothers-in-law to distinguish the effects of private information from social messaging.

First, I observed significant effects on knowledge: DILs and MILs across treatments had more knowledge overall, which was particularly interesting for MILs since they were not treated in two cross-randomized arms. Individual delivery outperformed group delivery for DILs only, with group treatment showing an attenuating effect. Second, individual delivery boosted short-term gains in ANC visits and IFA consumption, whereas group delivery took longer to effect change. Finally, involving MILs significantly increased health-seeking behaviors, such as attending additional hospital training and improving post-delivery maternal and infant outcomes.

This study is the first to provide experimental evidence on the influence of mothers-in-law on prenatal care, highlighting their role as significant household decision-makers. Further research is needed to understand treatment mechanisms and to extend intrahousehold bargaining models to include mothers-in-law, where interests may not always align.

The previous study demonstrates the effectiveness of intensive in-person health information delivery to pregnant women and their mothers-in-law. However, such interventions are not always feasible or cost-effective. Chapter 4 evaluates instead the impact of a lower-cost mobile messaging service that delivers postnatal care information to the entire household from birth through six weeks postpartum. This chapter highlights the impact of a low-effort digital intervention accessible to the whole household.

I analyze data from a cluster randomized experiment involving 24 hospitals in four states in India. In this study, 15 hospitals were provided access to information via WhatsApp, while 9 received in-hospital standard-of-care information. We recruited 21,937 mothers, primarily of lower socioeconomic status, over 10 months to participate in the study. I find significant positive impacts across most neonatal and maternal care practices examined, including increased breastfeeding, recommended cord care practice, and skin-to-skin care with mothers and fathers. Additionally, I observed significant and positive impacts on maternal dietary practices, with adherence to guidelines advising against reducing food and water intake and avoiding food restrictions.

In summary, this thesis addresses critical gaps in understanding the dynamics of intrahousehold decision-making in India, particularly the influential role of mothers-in-law on perinatal health outcomes. By exploring the interactions between new mothers, their mothers, and mothers-in-law, as well as the impact of targeted health interventions, the research

highlights the complexity of family structures in LMICs and their implications for health policy. The findings underscore the importance of considering broader household influences beyond the immediate nuclear family when designing and implementing health interventions. As such, this work contributes to the literature on family dynamics and health in LMICs and provides insights for policymakers aiming to improve maternal and infant health outcomes in similar contexts.

Chapter 2

Investigating the role of family members in postnatal care: Evidence from mother-caregiver dyads in India

ABSTRACT

Objectives In this study, we examine the dynamics of new mothers relative to other family members in making caregiving decisions about postpartum maternal and infant care in four states in India. Specifically, we investigate the involvement of the father, maternal grandmother, and paternal grandmother of the newborn in household decision-making for infant and maternal care.

Methods We analyze data from 551 dyads of women with infants under six months and the family caregiver identified as providing the primary support in the postpartum period. We present descriptive statistics on 1) the identity of the primary decision-maker as independently reported by new mothers and caregivers and 2) how disagreements are resolved. Within each dyad, we examine the level of agreement on health decision-making between mothers and caregivers. We use logistic regression and Ordinary Least Squares (OLS) to analyze the association between caregiver identity, postpartum outcomes, and maternal mental well-being.

Results Our findings show that decisions in the household are predominantly made by a single person, either the birthing woman or one of the family caregivers – the father, maternal grandmother, or paternal grandmother of the newborn. Across all dyads, birthing women are more likely than other household members to name their caregivers as the sole decision-makers for infant care and their own. The involvement of birthing women in household decision-making is low, with less than a third of birthing women reporting involvement in either. Within-dyad agreement on the identity of sole decision-makers is low, with less than a third of dyads in agreement for both infant and maternal care decision-making. The identity of the family caregiver matters for maternal mental well-being. Birthing women experience

a higher level of mental well-being on a normalized index by 0.12 standard deviations (sd) when their primary caregiver is their own mother. In contrast, the mental well-being of the birthing women is negatively impacted by 0.12 sd when the caregiver is the mother-in-law. We also observe that the type of caregiver significantly impacts the postpartum recovery of the birthing woman. Specifically, birthing women whose caregivers are mothers-in-law are 15.4 percentage points less likely to be well post-delivery. We find no other significant associations between the type of caregiver and postpartum outcomes. [1]

[1]Note: This chapter presents results from an analysis conducted in collaboration with Jamie Johnston (Stanford University), Sahana SD (Noora Health), Shirley Yan (Noora Health), and Seema Murthy (Noora Health).

2.1 Introduction

The postpartum period is a critical time for the physical and mental recovery of the mother, as well as the optimal development of the newborn (Fahey and Shenassa (2013); Lopez-Gonzalez and Kopparapu (2023); Slomian et al. (2019)). A significant proportion of deaths and re-hospitalizations for both mothers and newborns occur in the first few weeks following birth (Lawn et al. (2004, 2005)). The Lancet's neonatal survival series highlights practical and cost-effective interventions that improve maternal and neonatal health outcomes by enhancing maternal nutrition, promoting breastfeeding, and ensuring adequate and timely neonatal care (Darmstadt et al. (2005); Knippenberg et al. (2005); Lawn et al. (2005); Martines et al. (2005)). However, these interventions often require considerable time and resources, which are frequently limited and pose implementation challenges (Darmstadt et al. (2005); Evans et al. (2005); Horton and Levin (2016)). Previous literature, such as the systematic reviews conducted by Martin et al. (2020) and Martin et al. (2021), highlight the positive impact of family and caregiver support on maternal health outcomes. Other studies have demonstrated the association between the involvement of family members who are also caregivers, and improved maternal mental health (Garcia-Esteve et al. (2008); Reid and Taylor (2015); Robertson (2003); Robertson et al. (2004)), maternal-infant bonding (Lutkiewicz et al. (2020); Ohara et al. (2017); Tichelman et al. (2019)), and increased uptake of breastfeeding (Aubel et al. (2021); Tomori et al. (2022).

In India, the postpartum period is characterized by a unique cultural context where women are considered vulnerable and reliant on other family members (especially women) within the household for support (Choudhry (1997); Withers et al. (2018)). Family caregivers in India greatly influence the mothers' decisions during their pregnancy and the postpartum period; evidence suggests that the stronger the relationship quality, the more likely the mother is to engage in WHO-recommended best practices (Allendorf (2010); Chandran et al. (2002); Gausia et al. (2009); Nguyen et al. (2019)). Nevertheless, the influence of different types of caregivers, especially mothers and mothers-in-law of the birthing woman, on health outcomes for both the mother and newborn remains poorly understood (Aubel (2012); Pulgaron et al. (2016); Sadruddin et al. (2019)). Additionally, the potential discordance between caregivers and mothers concerning postpartum care decisions adds further complexity to the caregiving dynamic (Allendorf (2010); Pulgaron et al. (2016); Vázquez-Vázquez et al. (2022)). Examining these intricate relationships is crucial for designing effective interventions and ensuring optimal postpartum health outcomes, particularly as maternal and infant mortality remains high in India (NFHS (2016b)).

Several barriers can impede caregivers' ability to support mothers effectively in the postpartum period; limited knowledge, inadequate resources, and competing responsibilities often hinder caregivers from providing comprehensive care (Gaikwad et al. (2020)). Additionally, cultural beliefs, social norms, and economic constraints can further contribute to suboptimal postpartum care practices (Kesterton and Cleland (2009); Yan et al. (2023)). This study explores the dynamics within new mother and caregiver dyads, investigating the role of caregivers (primarily the father, maternal, and paternal grandmother of the newborn) and

their influence on postpartum care in four states in India. In this study, we explore three key research questions: 1) How do different family caregivers influence household health decision-making, particularly in determining responsibilities for the mother's health versus the infant's health? 2) How are conflicts regarding decision-making resolved within the household? 3) How do these caregiver relationships impact postpartum health outcomes, including mental well-being? We hypothesize that 1) decisions regarding the infant's health are made by multiple members of the household, and the type of family caregiver during the postpartum period is crucial. We expect that women cared for by their mothers-in-law will have poorer health outcomes compared to those cared for by their own mothers or spouses.

2.2 Materials and Methods

2.2.1 Study design and participants

In this study, we present findings from a cohort of women who had recently given birth in hospitals where the non-profit organization Noora Health, through its local partner organizations, implements its neonatal Care Companion Program (CCP), a health education program that provides in-hospital training sessions and digital messaging on postnatal care to birthing women and their family caregivers. Noora Health aims to make family caregiver education part of the standard of care to strengthen postnatal care quality in the home and improve maternal and neonatal health outcomes. Additional details on CCP can be found in Yan et al. (2023). CCP is integrated into all district hospitals and specific medical colleges in the states included in this study (Karnataka, Madhya Pradesh, Maharashtra, and Punjab). All birthing women and family caregivers present in the postnatal wards during CCP training are invited to participate.

Figure 2.1 shows the study sampling flow. The sample of birthing women in the study was randomly drawn from a larger sample of 18,436 birthing women who delivered in 28 district hospitals in the four states between September 2018 and May 2020 and completed a post-discharge survey conducted by Noora Health within one month after birth. Our sample was restricted to birthing women with infants six months of age or younger at the time of the phone survey. We stratified our sample by state (each strata was sampled proportionate to size) and whether the infant fell sick at home post-discharge to ensure that our sample was reflective of the larger sample of birthing women. Birthing women whose infants had died and who spoke a language other than Hindi, Kannada, Marathi, or Punjabi were excluded from the sample due to ethical reasons and the unavailability of qualified survey staff with proficiency in languages other than the ones mentioned above. In total, we sampled 1,355 birthing women. The available budget and surveying capacity of the Noora Health field team determined this sample size. We recruited participants via phone between May and June of 2020. Of the total sample recruited, 822 birthing women were successfully contacted and consented to participate. We did not collect any data from women who did not consent.

We first administered a 30-minute phone survey to consenting birthing women. At the

end of the survey, we asked birthing women to provide their primary postpartum caregiver's name and contact details. We then contacted and independently surveyed this caregiver. A total of 551 caregivers consented to participate in the study. Because this study aims to analyze the birthing woman and caregiver dyads, we restrict our analytic sample to the 551 pairs of birthing women and caregivers for whom we have complete dyad data.

2.2.2 Data collection

Our study draws upon two sources of data. We pooled phone survey data collected during recruitment for this study, with post-discharge data collected by Noora Health within 30 days after birth for the same women in our study(Subramanian et al. (2020)). Post-discharge data collected from birthing women includes information on the age of the birthing woman; data on prior pregnancies of the birthing woman, including the number of times they have been pregnant, whether this is their first child, and number of existing children; data on postpartum practices, including exclusive breastfeeding, skin-to-skin care, umbilical cord care, and maternal diet restrictions; and health outcomes including hospital readmissions of infants and birthing women and mental health of birthing women.

Phone surveys administered to birthing women collected household demographic data, including household size, rural residence, and socioeconomic status measured by an asset score and below-poverty line status; health knowledge as proxied by a series of questions asked about COVID-19 awareness and prevention due to the timing of the survey coinciding with the start of the COVID-19 pandemic; family caregiver support and intra-household decision making about maternal and infant care; and maternal mental well-being.

The phone survey administered to caregivers included the same questions as the birthing woman survey, except for questions about mental well-being.

2.2.3 Measures

We describe the types of family caregivers that provide postpartum support to birthing women. While the birthing women reported many different family relationship types among their primary caregivers, we limit our primary analyses to the three most frequently mentioned relationship types: 1) the spouse of the birthing woman, 2) the mother of the birthing woman, and 3) the mother-in-law of the birthing woman. These three relationship types comprise 74.05 percent of family caregivers identified (see Appendix S2). Other commonly mentioned relationship types include sister, sister-in-law, daughter, and father.

We leverage data collected from family caregivers to examine the level of agreement regarding health decision-making within the birthing women and caregiver dyads. Figure 2.2 describes the flow of survey questions investigating health decision-making for the infant and separately for the birthing woman. Each dyad member was asked to identify 1) the identity of the primary decision maker(s) (single or multiple) and 2) how disagreements are resolved (by a single decision maker, joint consensus, or by deferring to the advice of an

ASHA or medical doctor). Within each dyad, the birthing woman's and the caregiver's responses were compared to understand the within-dyad agreement.

Finally, we examine the association between family caregiver type, postpartum care practices, and maternal mental well-being. The postpartum practices that we examine include the following indicators: 1) exclusive breastfeeding, 2) practice of skin-to-skin care, 3) unsafe umbilical cord care (i.e., application of anything to the cord), 4) restriction of the birthing woman's diet, 5) if the infant fell sick post-discharge, 6) if the birthing woman fell sick post-discharge, and 7) missed vaccinations for the infant. We constructed a maternal mental well-being index from a series of yes / no statements asking birthing women about their anxieties, caregiving load, stress, and available support. We constructed the index by taking the unweighted sum with higher values indicating poorer mental well-being and standardizing around the mean for ease of interpretation. This is a novel index, and has not been validated elsewhere.

2.2.4 Statistical analysis

All statistical analyses were conducted in Stata 16 and Stata 18. To estimate the association between the identity of the primary caregiver and the various health outcomes, we use logistic regression when the dependent variables are binary and Ordinary Least Squares (OLS) when the dependent variable is non-binary. In both model types, the reference category is the spouse and we include indicator variables for the mother and the mother-in-law.

We include covariates related to both the birthing woman and the caregivers. These covariates include the age of the birthing woman and the caregiver, household size, number of existing children, and parity, as well as indicators for rural residence and below-poverty line status. Additionally, we include an asset score, where a higher score indicates better socioeconomic status, and a health knowledge index constructed as a standardized unweighted sum of correct responses to questions related to COVID-19. Additionally, we include state-fixed effects to hold constant state-wise variations.

2.2.5 Ethics review

This study received ethics approval from the Institutional Review Board (IRB) at Stanford University, California (protocol number IRB-55003), and the ACE Ethics Committee based in Bangalore, India. At the start of each survey, a consent script was read to participants in their local language, and participants were asked to provide verbal consent. Only those who provided consent were included in the study. Participants were not compensated for their time financially or otherwise. The primary data with identifiable information were collected and maintained in India; de-identified data were shared with collaborators for analysis.

2.3 Results

We begin the discussion of our findings with Table 2.1 and Table 2.2, which describes the birthing women included in our sample, and their primary caregivers comprising the dyads. Subsequently, in Table 2.3 and 2.4, we present a descriptive analysis of household decision-making within the dyads. Finally, in Table 2.5, we describe the association between the postpartum outcomes of the birthing woman and the type of primary caregiver.

2.3.1 Dyad description

Table 2.1 presents the descriptive characteristics of the birthing women in our sample. The mean age of the women is 24.14 years (sd=3.66). Most women live in rural villages (66.79 percent), and below the poverty line (69.51 percent), owning 4.86 out of 7 everyday household items on average. The average household size is 4.50. Women have been married for 4.64 years, and more than half (54.36 percent) are first-time mothers. On the health knowledge index, the women score low, with a mean score of 3.94 out of 15.

551 birthing women identified a primary caregiver for postpartum recovery and infant care. The most common caregivers include the birthing woman's spouse (30.85 percent), mothers (25.78 percent), and mothers-in-law (17.42 percent). Other relationships mentioned include but are not limited to, the sister, sister-in-law, and the birthing woman's father (see Appendix S1).

Table 2.2 presents the descriptive characteristics of the most common primary caregivers: the spouse, mother, and mother-in-law, along with a column that consolidates all other caregivers. We see that spouses are older than the birthing women, at an average age of 30.02 years. The mothers-in-law are average 48.75 years, compared to mothers with an average age of 43.62 years. As with the birthing women's sample in Table 2.1, more than half of caregivers live in rural villages. Among these three types of caregivers, spouses tend to be more educated, with a higher percentage having completed secondary school and higher than secondary education. In contrast, most mothers and mothers-in-law have only completed primary education. Spouses score higher on the COVID-19 health knowledge index (4.28 out of 15) compared to mothers (2.92 out of 15) and mothers-in-law (3.16 out of 15).

Tables 2.3 and 2.4 describe health decision-making for 1) infant care and 2) maternal care. As shown in Figure 2.2, in each dyad, birthing women and caregivers were asked to identify the primary decision maker(s) and decision maker(s) when there was a disagreement in the household about the health of the infant or birthing woman. The tables also show the percentage of dyads in which both members agree on all questions. The analysis was restricted to core dyads (N=408) where the caregiver was a spouse, mother, or mother-in-law.

2.3.2 Infant care decision-making

2.3.2.1 Primary decision-maker for infants

Table 2.3 shows the results of decision-making for the infant's health by dyad type. The majority of respondents indicated that a single person made decisions for the infant's health. Birthing women were most likely to name their primary caregiver (dyad member), as the decision-maker; 40.15 percent in the spouse dyad, 60.75 percent in the mother dyad and 45.83 percent in the mother-in-law dyad. Across all dyads, women were less likely to name themselves as the single decision maker, with 27.74, 21.50, and 22.22 percent identifying themselves, respectively. Across all dyads, mothers and mothers-in-law are frequently identified as decision-makers.

Among caregivers naming a single decision maker, spouses (fathers of the infants) were more likely to name themselves (45.16 percent). In contrast, mothers and mothers-in-law were more likely to consider the birthing woman the sole decision-maker. After the birthing women, mothers, and mothers-in-law were most likely to identify themselves as sole decision-makers. Few mothers and mothers-in-law identified spouses as decision-makers.

In Table 2.3, we also show agreement on single decision-maker identity. Agreement is similar for the spouse and mother-in-law dyads (28.21 and 28.57 percent, respectively) and slightly lower for the mother dyad (20.16 percent).

Among responses indicating multiple decision-makers, we examine the involvement of the birthing woman (mother of the infant), the spouse (father of the infant), the mother (maternal grandmother), and the mother-in-law (paternal grandmother of the infant). More than half of birthing women in spouse and mother dyads are involved in decisions (60.61 percent and 71.43 percent). Fewer birthing women are involved in mother-in-law dyads (45.83 percent).

Among the caregiver responses, we see the proportion of birthing women involved in infant care decisions made jointly is similar to those reported by the birthing women. However, mothers-in-law report lower birthing woman involvement compared to birthing women within the mother-in-law dyad (31.58 vs. 45.83 percent). We also see that spouses and mothers-in-law report the spouse being involved, whereas the mothers of birthing women rarely include spouses. Both spouses and mothers do not consider mothers-in-law involved, but a 73.68 percent of mothers-in-law consider themselves involved.

Table 2.3 also shows birthing women's involvement in decision-making, either as a single or joint decision-maker. Birthing women report being involved in a third of dyads (34.12 percent spouse, 33.8 percent mother, 28.13 percent mother-in-law). Spouses and mothers-in-law report slightly higher involvement, and mothers report the highest involvement.

2.3.2.2 Resolution of infant-care disagreements

Finally, Table 2.3 presents data on the resolution of disagreements related to health decision-making for the infant. Similar to the previous results, birthing women tend to defer the

ultimate decision-making during disagreements to their dyad member: 46.15 percent in the spouse dyad, 60 percent in the mother dyad, and 64 percent in the mother-in-law dyad.

2.3.3 Maternal care decision-making

2.3.3.1 Primary decision-makers for birthing women

Table 2.4 shows decision-making for the birthing woman's health. Similar to Table 2.3, we present the results for the birthing women and caregivers by core dyad. Most birthing women and caregivers indicated that a single person makes the maternal care decisions. Birthing women in spouse dyads were most likely to name their spouse as the decision-maker (79.71 percent). Birthing women in mother and mother-in-law dyads were also more likely to name the caregiver as the sole decision maker, although to a lesser degree. Across all types of core dyads, women were less likely to name themselves the single decision-maker for her own health, with 12.32, 29.91, and 8.33 percent identifying themselves in spouse, mother, and mother-in-law dyads, respectively. Across all dyad types, birthing women identify spouses as primary decision makers for maternal care decisions at a higher rate than for infant-care decisions.

Among caregivers, spouses named themselves as decision-makers (45.11 percent) nearly as often as they named the birthing woman (41.35 percent). Compared to spouses, mothers and mothers-in-law were more likely to consider the birthing woman the primary single decision-maker for her health, with 64.29 percent of mothers and 56.00 percent of mothers-in-law identifying the birthing woman. Few mothers and mothers-in-law indicated that spouses made decisions for the birthing woman's health.

Table 2.4 also shows dyads' agreement on the single decision-maker for maternal care. Agreement is higher in spouse (32.92 percent) and mother (27.41 percent) dyads, and lowest in mother-in-law dyads (17.05 percent).

Among responses indicating multiple decision-makers, we examine the involvement of the birthing woman and each caregiver. More birthing women report involvement in decision-making for their care in the spouse dyad (40.63 percent) compared to the mother and mother-in-law dyads (22.86 and 25.00 percent, respectively). Among the caregiver responses, we see the proportion of birthing women involved in decisions regarding their care is much higher than those reported by the birthing women (75.68, 68.75, and 47.62 percent, respectively). Spouses are likewise included as multiple decision-makers across all dyad types at similar rates.

Similar to Table 2.3, we show the proportion of times the birthing woman is included as a decision-maker for her health across single and household-level decision-making. Across all dyad types, birthing women are much less likely to report their involvement in decision-making compared to caregivers reporting the involvement of birthing women. Birthing women reported involvement in under a third of dyads across all types (17.65, 28.17, and 13.54 percent in spouse, mother, and mother-in-law dyads, respectively. Caregivers reported

birthing women involvement in a majority of dyads across all types (48.82, 64.79, and 54.17 percent in spouse, mother, and mother-in-law dyads, respectively).

2.3.3.2 Resolution of maternal-care disagreements

Table 2.4 also presents data on resolving disagreements related to health decision-making for the birthing woman. Similar to the resolution of infant-care disagreements (Table 3), birthing women tend to defer the ultimate decision-making during disagreements to their dyad member (78.18 percent in spouse dyads, 46.77 percent in mother dyads, and 44.74 in mother-in-law dyads).

2.3.4 Postpartum care and mental well-being by caregiver type

Table 2.5 presents the estimated associations between the type of primary caregiver and postpartum care practices for birthing women. The analysis revealed several significant associations between postpartum outcomes and the type of primary caregiver. Notably, when the caregiver was the birthing woman's own mother, her mental well-being was significantly better than the reference group which includes the spouse. On average, the mental well-being of the birthing woman was 0.12 sd higher ($p < 0.1$). Conversely, the mental well-being of the birthing woman is significantly negatively associated with the caregiver being her mother-in-law, 0.12 sd lower on the mental well-being index ($p < 0.1$).

We observed few significant associations between the type of caregiver and postpartum care practices. However, we did observe that having a mother-in-law as a caregiver was associated with a 0.15 percentage point (pp) decrease in the birthing woman being well post-discharged compared to the reference group of spouses($p < 0.05$).

2.4 Discussion

In this study, we examine the role of family caregivers in India in the postpartum period, investigating which household members provide primary support to birthing women and how decisions are made about maternal and infant care. Our findings show that the three most common family members supporting birthing women are the birthing woman's spouse, mother, and mother-in-law. Our study contributes to the literature by using birthing woman-caregiver dyad data to examine how birthing women and their family caregivers perceive how decisions are made and the extent to which they agree, offering a unique glimpse into the spousal and intergenerational dynamics of household decision-making.

Family caregivers play a significant role in postpartum decision-making, often acting as the sole decision-maker for questions about the care of both infants and birthing women. We observe that in the majority of households, decisions are made by a single person. Across all dyad types, birthing women were more likely to name their caregiver as the sole decision maker, not just for infant care but also for decisions about their own health. Caregivers

were likewise more likely to name themselves as the sole decision maker over the birthing woman, although at slightly lower rates. Households shift to increased joint decision-making to resolve disagreements. Nevertheless, family caregivers are involved in decision-making in nearly all households in the study.

Our study suggests that birthing women overwhelmingly do not view themselves as primary household decision-makers. For both infant and maternal care decision-making, the involvement of birthing women as a primary decision-maker is notably low, particularly from the perspective of birthing women themselves. Birthing women report involvement as a primary decision maker, either as a sole decision maker or as part of joint decision making, in roughly a third of the dyads observed for infant care decisions and under a third of dyads for maternal care decisions.

In contrast, caregivers do report a higher involvement of birthing women, with slightly higher rates for infant care, and substantially higher for maternal care (over 50 percent of dyads). This mismatch, with birthing women deferring decision-making to caregivers, is reflected in low levels of agreement within the dyads about the identity of sole decision-makers. Agreement on sole decision-making in under a third of dyads for both infant and maternal care. For both primary decision-making and resolution of disagreements, birthing women assigned more authority to their caregiver counterpart, while caregivers reported deferring more authority to birthing women. The presence of multiple family decision-makers in some households may also contribute to the observed discrepancies and complicate the classification of decision-making roles.

Our study also points to important distinctions regarding the identity of the family caregivers, with patterns diverging depending on whether the primary caregiver is the birthing woman's spouse, own mother, or mother-in-law. We observe notable gender dynamics at play with respect to infant care. According to birthing women, spouses are far less likely to be involved with infant care decisions compared to decisions about maternal health, suggesting birthing women may feel more authority for infant care than for autonomy over their own care. Female caregivers (i.e., mothers and mothers-in-law) are unlikely to assign infant care decision-making authority to infants' fathers.

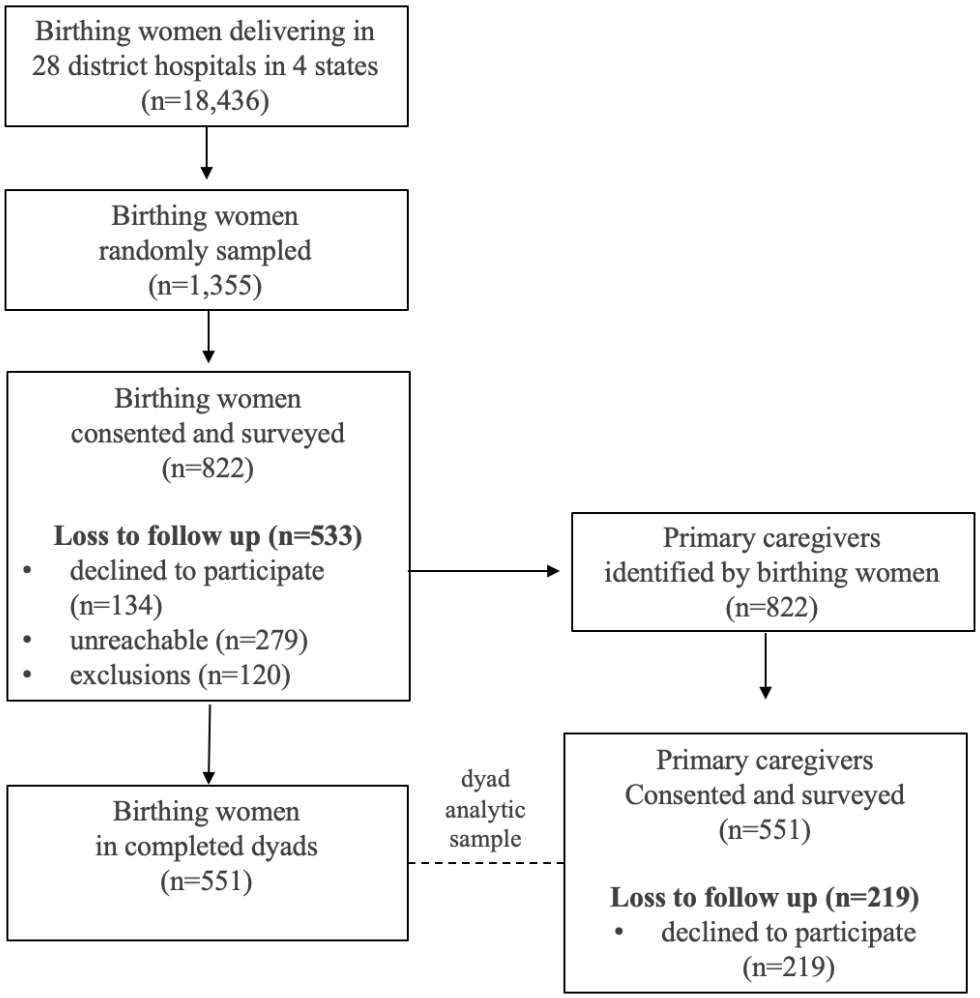
Furthermore, the identity of caregivers appears to matter for the mental well-being of birthing women. Having one's own mother as a primary caregiver is strongly positively associated with better mental well-being compared to other types of primary caregivers, while having a mother-in-law as a primary caregiver is negatively associated with mental well-being. We also note that birthing women's mothers are more likely to assign decision-making authority to their daughters compared to birthing women's spouses and mothers-in-law. While birthing women derive the most agency and mental well-being benefits from caregiving provided by their mothers, it is important to note that this support may be short-lived, as most women in India typically move back into their spouse's family home shortly after childbirth (Allendorf (2017)).

Our findings have important implications for health policymakers and for developing programs and interventions designed to improve maternal-child care in the postpartum period. Programs and intervention design must account for family structures and distinctions in

household decision-making to ensure that information and support is directed to those who influence household decision-making.

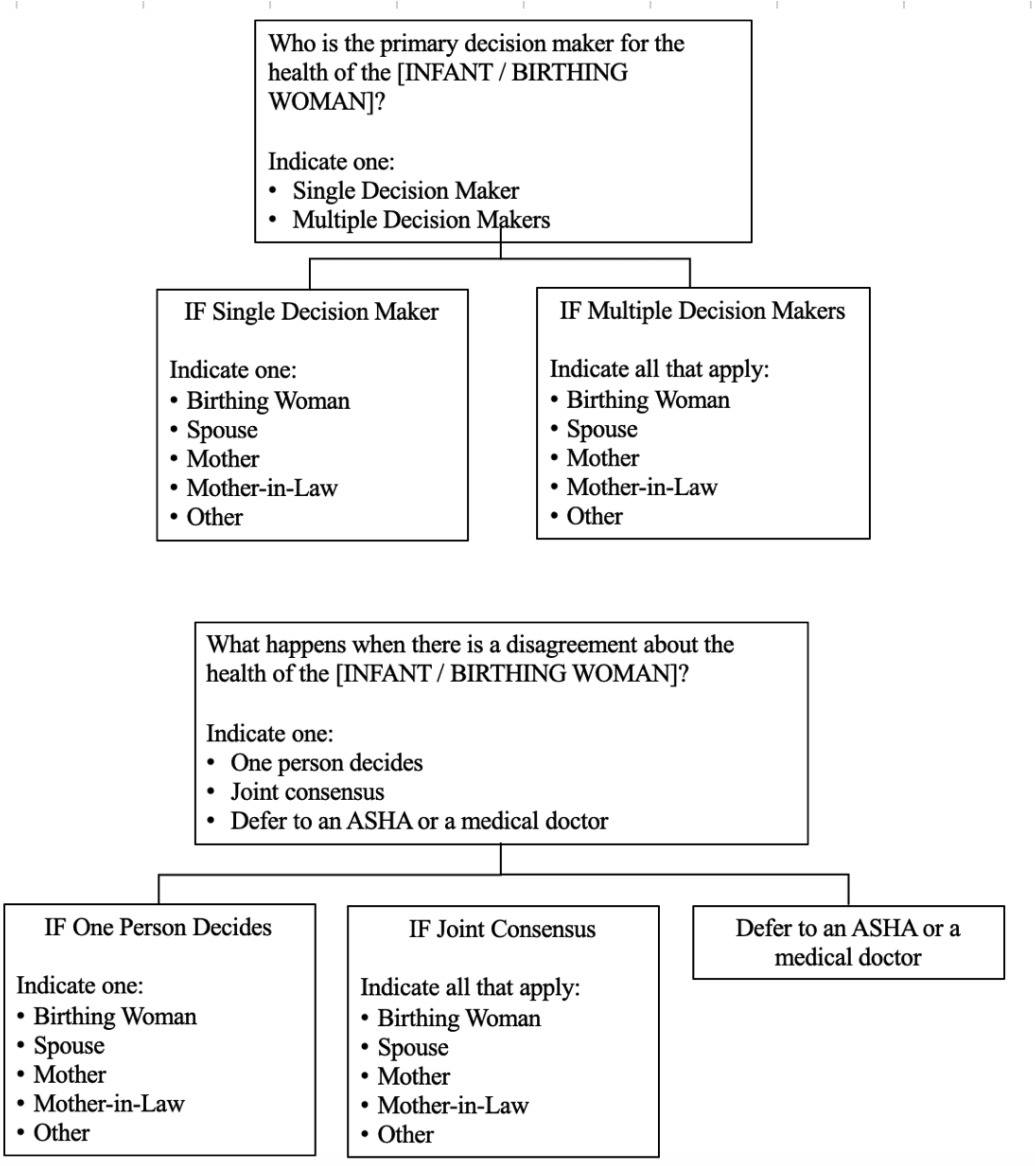
As in India, households in many LMICs are predominantly intergenerational [39]. Our research underscores the importance of designing interventions sensitive to these nuances, acknowledging that family caregivers must be incorporated into health education and can be instrumental in improving postpartum health outcomes. This study is the first to examine this household dynamic by studying family member dyads and decision-making, especially around health decision-making. However, our study has limitations: it lacks a quasi-experimental or experimental design, and has a limited sample size from specific socioeconomic groups. These limitations restrict our ability to fully analyze the extent of these dynamics' impact on mental health and additional postpartum outcomes. Future research should study the effect of this dynamic on health decision-making, including health-seeking behavior, and the best way to design postpartum support programs to improve maternal and infant health, that involve other family members and deliver health information at the household level.

Figure 2.1: Study flow diagram



Notes: This figure presents the study sampling flow. The sample is restricted to birthing women with infants of six months of age or younger. Exclusions include women whose infants had died and who spoke a language other than Hindi, Kannada, Marathi or Punjabi. The final analytic sample is restricted to 551 pairs of birthing women and caregivers.

Figure 2.2: Health decision-making survey flow



Notes: Within each dyad, the birthing woman and her identified caregiver were asked to respond to the survey flow described in this figure. Respondents were asked to separately describe decision making for the health of 1) the infant and 2) the birthing woman. Birthing woman and caregiver responses in each dyad were compared to measure within-dyad agreement on health decision making.

Table 2.1: Birthing woman descriptive characteristics

	Birthing woman (n = 551)
Age	24.14 ± 3.66
Live in a rural village	368 (66.79)
State	
Madhya Pradesh	176 (31.94)
Karnataka	254 (46.10)
Punjab	69 (12.52)
Maharashtra	52 (9.44)
Caste	
General	162 (36.00)
Scheduled caste (SC)	107 (23.78)
Scheduled tribe (ST)	56 (12.44)
Not specified	226 (41.02)
Primary spoken language	
Hindi	285 (51.72)
Kannada	177 (32.12)
Punjabi	43 (7.80)
Marathi	46 (8.35)
Socio-economic status	
Ownership of HH goods - out of 7	4.86 ± 0.05
Ownership of Below Poverty Line (BPL) Card	383 (69.51)
Household characteristics	
Household size	4.50 ± 0.07
Number of years married	4.64 ± 0.15
Number of previous children	1.27 ± 0.03
Birth-related characteristics	
First-time mothers	299 (54.36)
Postpartum residence in maternal home	385 (69.87)
COVID-19 Health knowledge index - score out of 15	3.94±2.03

Notes: This table presents the descriptive characteristics of birthing women in the analysis sample. Data are displayed as either mean±SD or n(%). Socio-economic status is presented as a score by counting the ownership of seven common household goods. Ownership of the Below Poverty Line (BPL) card is an indicator for whether the respondent's family has a government issued card. Postpartum residence in maternal home is an indicator for whether the respondent (birthing woman) lived in their mother's home immediately following birth. The health knowledge index is constructed by taking the sum of the respondent's score on a 6 knowledge questions relating to COVID-19.

Table 2.2: Primary caregiver characteristics

	All dyads: Caregiver survey (n=551)			
	Spouse (n=170)	Mother (n=142)	Mother-in-law (n=96)	Other caregivers (n=143)
Age	30.02 ± 6.79	43.62 ± 7.51	48.75 ± 7.52	37.90 ± 13.35
Live in a rural village	110 (64.71)	115 (80.99)	60 (62.5)	95 (66.43)
Highest level of education completed				
Primary school completed	25 (14.71)	91 (64.08)	61 (63.54)	43 (30.07)
Less than secondary school	94 (55.29)	33 (23.24)	15 (15.62)	51 (35.66)
Secondary school completed	29 (17.06)	1 (0.70)	3 (3.12)	12 (8.39)
Higher than secondary school	18 (10.59)	0 (0)	1 (1.04)	15 (10.49)
Do not know	4 (2.35)	17 (11.97)	16 (16.67)	22 (15.38)
Health knowledge index - score out of 15	4.28 ± 0.15	2.92 ± 0.13	3.16 ± 0.20	3.80 ± 0.17

Notes: This table presents the descriptive characteristics of the caregivers in the analysis sample. Data are displayed as either mean±SD or n(%). We combine primary caregiver relationships that don't include the spouse, mother, and mother-in-law as other caregivers. The health knowledge index is constructed by summing the respondent's score on a 6 knowledge questions relating to COVID-19.

Table 2.3: Dyad decision making: infant care decisions

	Core dyads: birthing woman survey (n=408)			**Core dyads: caregiver survey (n=408)**		
Primary caregiver	Spouse (n=170)	Mother (n=142)	Mother-in-law (n=96)	Spouse (n=170)	Mother (n=142)	Mother-in-law (n=96)
Primary decision-maker for the baby						
Single decision-maker	**137 (80.59)**	**107 (75.35)**	**72 (75.00)**	**124 (72.94)**	**118 (83.09)**	**77 (80.20)**
Birthing woman (self)	38 (27.74)	23 (21.50)	16 (22.22)	37 (29.83)	55 (46.61)	30 (38.96)
Spouse	55 (40.15)	9 (8.41)	7 (9.72)	56 (45.16)	9 (7.62)	5 (6.49)
Mother	17 (12.41)	65 (60.75)	10 (13.89)	15 (12.10)	41 (34.74)	11 (14.28)
Mother-in-law	20 (14.60)	3 (2.80)	33 (45.83)	5 (4.03)	1 (0.84)	24 (31.17)
Other	7 (5.11)	7 (6.54)	6 (8.33)	11 (8.87)	12 (10.16)	7(9.09)
Dyads agreed on identity of single decision-maker	44 (28.21)	26 (20.16)	24 (28.57)	-	-	-
Multiple decision-makers	**33 (19.41)**	**35 (24.65)**	**24 (25.00)**	**46 (27.06)**	**24 (16.90)**	**19 (19.79)**
Birthing woman involved	20 (60.61)	25 (71.43)	11 (45.83)	28 (60.87)	19 (79.17)	6 (31.58)
Spouse involved	24 (72.73)	4 (11.43)	12 (50.00)	28 (60.87)	3 (12.50)	7 (36.84)
Mother involved	5 (15.15)	28 (80.00)	9 (37.50)	12 (26.09)	5 (20.83)	7 (36.84)
Mother-in-law involved	9 (27.27)	1 (2.86)	15 (62.50)	5 (10.87)	1 (4.17)	14 (73.68)
Dyads with birthing women as a decision-maker	58 (34.12)	38 (33.80)	27 (28.13)	65 (38.24)	74 (52.11)	36 (37.50)
Resolution of disagreements for decisions about the baby						
Single decision-maker	**39 (22.94)**	**60 (42.25)**	**25 (26.04)**	**47 (27.64)**	**53 (37.32)**	**34 (35.42)**
Birthing woman (self)	12 (30.77)	15 (25.00)	3 (12.00)	25 (53.19)	31 (58.49)	21 (61.76)
Spouse	18 (46.15)	4 (6.67)	6 (24.00)	8 (17.02)	4 (7.55)	0 (0.00)
Mother	2 (5.13)	36 (60.00)	0 (0.00)	7 (14.89)	5 (9.43)	1 (2.94)
Mother-in-law	4 (10.26)	1 (1.67)	16 (64.00)	2 (4.25)	0 (0.00)	6 (17.65)
Multiple decision-makers	**81 (47.65)**	**30 (21.13)**	**38 (39.59)**	**74 (43.53)**	**38 (26.76)**	**34 (35.42)**
Birthing woman involved	26 (32.10)	8 (26.67)	18 (47.37)	30 (40.54)	28 (73.68)	19 (55.88)
Spouse involved	65 (80.25)	13 (43.33)	23 (60.53)	60 (81.08)	19 (50.00)	18 (52.94)
Mother involved	1 (1.23)	22 (73.33)	3 (7.89)	9 (12.16)	6 (15.79)	4 (11.76)
Mother-in-law involved	23 (28.40)	4 (13.33)	28 (73.68)	4 (5.41)	1 (2.63)	12 (35.29)

Notes: This table displays descriptive statistics related to decision-making for infant care. Data are displayed as n(%). The responses from birthing women are organized according to the dyad they identify with, allowing for comparison within dyad type responses. In cases of dyad agreement on a single decision-maker, this table excludes agreements marked as "Other" in the survey. Similarly, for the resolution of disagreements, it does not present data related to the two additional options: 1) asking a community health worker or doctor, and 2) other.

Table 2.4: Dyad decision making: maternal care decisions

	Core dyads: birthing woman survey (n=408)			Core dyads: caregiver survey (n=408)		
Primary caregiver	Spouse (n=170)	Mother (n=142)	Mother in Law (n=96)	Spouse (n=170)	Mother (n=142)	Mother in Law (n=96)
Primary decision-maker for the birthing woman						
Single decision-maker	**138 (81.18)**	**107 (75.35)**	**76 (79.17)**	**133 (78.24)**	**126 (88.73)**	**75 (78.13)**
Birthing woman (self)	17 (12.32)	32 (29.91)	8 (8.33)	55 (41.35)	81 (64.29)	42 (56.00)
Spouse	110 (79.71)	**20 (18.69)**	**32 (33.33)**	60 (45.11)	11 (8.73)	5 (6.66)
Mother	1 (0.72)	46 (42.99)	2 (2.08)	8 (6.02)	24 (19.05)	2 (2.66)
Mother-in-law	6 (4.35)	2 (1.87)	30 (31.25)	4 (3.01)	1 (0.79)	16 (21.33)
Other	4 (2.90)	7 (6.54)	4 (4.17)	6 (4.51)	9 (7.14)	10 (13.33)
Dyads agreed on identity of single decision-maker	53 (32.92)	37 (27.41)	15 (17.05)	-	-	-
Multiple decision-makers	**32 (18.82)**	**35 (24.65)**	**20 (20.83)**	**37 (21.76)**	**16 (11.27)**	**21 (21.87)**
Birthing woman involved	13 (40.63)	8 (22.86)	5 (25.00)	28 (75.68)	11 (68.75)	10(47.62)
Spouse involved	22 (68.75)	11 (31.43)	15 (75.00)	25(67.57)	7 (43.75)	13(61.90)
Mother involved	1 (3.13)	29 (82.86)	1 (5.00)	11 (29.73)	4 (25.00)	2 (9.52)
Mother-in-law involved	17 (53.13)	4 (11.43)	17 (85.00)	7(18.92)	2 (12.50)	8(38.10)
Dyads with birthing women as a decision-maker	30 (17.65)	40 (28.17)	13 (13.54)	83 (48.82)	92 (64.79)	52 (54.17)
Resolution of disagreements for decisions about the birthing woman						
Single decision-maker	**55 (32.35)**	**62 (43.66)**	**38 (39.58)**	**55 (32.35)**	**60 (42.25)**	**30 (31.25)**
Birthing woman (self)	8 (14.55)	19 (30.65)	9 (23.68)	35 (63.64)	40 (66.67)	19 (63.33)
Spouse	43 (78.18)	12 (19.35)	9 (23.68)	11 (20.00)	5 (8.33)	1 (3.33)
Mother	0 (0.00)	29 (46.77)	2 (5.26)	4 (7.27)	2 (3.33)	1 (3.33)
Mother-in-law	3 (5.45)	1 (1.61)	17 (44.74)	2 (3.64)	1 (1.67)	2 (6.67)
Multiple decision-makers	**69 (40.59)**	**29 (20.42)**	**26 (27.08)**	**73 (42.94)**	**31 (21.83)**	**38 (39.58)**
Birthing woman involved	19 (27.54)	6 (20.69)	8 (30.77)	29 (39.73)	18 (58.06)	19 (50.00)
Spouse involved	67 (97.10)	12 (41.38)	20 (76.92)	62 (84.93)	17 (54.84)	18 (47.37)
Mother involved	2 (2.90)	19 (65.52)	1 (3.85)	12 (16.44)	5 (16.13)	5 (13.16)
Mother-in-law involved	17 (24.64)	2 (6.90)	19 (73.08)	6 (8.22)	2 (6.45)	15 (39.47)

Notes: This table displays descriptive statistics related to decision-making for maternal care. Data are displayed as n(%). The responses from birthing women are organized according to the dyad they identify with, allowing for comparison within dyad type responses. In cases of dyad agreement on a single decision-maker, this table excludes agreements marked as "Other" in the survey. Similarly, for the resolution of disagreements, it does not present data related to the two additional options: 1) asking a community health worker or doctor, and 2) other.

Table 2.5: Postpartum health outcomes of birthing woman by type of primary caregiver

	(1)			(2)				
	Mother			**Mother-in-law**			**Mean of reference group (Spouse)**	
	RD	*p*-value		RD	*p*-value			N
Mental well-being index	0.120	0.080	*	-0.121	0.091	*	0.000	408
Practicing exclusive breastfeeding	0.078	0.138		0.075	0.155		0.794	408
Practicing skin-to-skin care	-0.143	0.292		-0.145	0.383		0.606	112
Practicing safe cord care	0.084	0.125		0.080	0.164		0.429	408
Practicing unrestricted dietary practics	-0.021	0.697		0.086	0.195		0.194	408
Infant is well post-discharge	-0.037	0.539		0.047	0.387		0.782	408
Birthing woman is well post-discharge	-0.047	0.422		-0.154	0.019	**	0.775	408
Infant's vaccinations are current	-0.011	0.828		0.011	0.815		0.850	408

Notes: Notes: This table presents the results of a logistic regression of the primary outcomes by type of primary caregiver. Each row represents a separate regression. The maternal mental well-being index is a continuous outcome constructed from a series of yes / no statements asking birthing women about their anxieties, caregiving load, stress, and available support. The index is cacluated by taking the unweighted sum with higher values indicating poorer mental well-being and standardizing around the mean of the reference group. All other dependent variables presented are indicators that are 0 if the behavior was not practiced, and 1 if the behavior was practiced. The independent variable is 0 if the spouse is the caregiver, 1 if the mother is the caregiver, and 2 if the mother-in-law is the caregiver.Covariates included in the mode are mother's age, caregiver's age, household size, number of previous children, parity, rural residence, below poverty line status, asset score, and health knowledge score. Standard errors (not shown here) are robust, and we include state fixed efffects. * denotes statistical significant at 10 pct, ** at 5 pct, and *** at 1 pct level. RD: risk difference.

Chapter 3

The role of the mother-in-law and social norms in the demand for maternal health services: Evidence from a field experiment in India

ABSTRACT

This paper investigates the impact of differentiated health messaging and social learning on antenatal care (ANC) visits and Iron and Folic Acid (IFA) tablet consumption for pregnant women or daughters-in-law using a randomized controlled trial in India. Specifically, we examine providing information to pregnant daughters-in-law in private or jointly with their co-residing mothers-in-law in the context of traditional multigenerational households, characterized by low female agency, high conformity to gender norms, and collective health decision-making. In a field experiment conducted in the Indian state of Madhya Pradesh, we cross-randomized health information delivery on the importance of ANC visits and IFA along two social dimensions.

First, we varied at the individual level, randomizing each pregnant women to receive information either jointly with her mother-in-law or without her mother-in-law. We further varied delivery at the village-level, with information delivered either privately within the household or else jointly along with others in the village, to distinguish the effect of private information from social messaging. We hypothesize that the effects on our outcomes are larger at the individual level with the mother-in-law present since they control decision-making in the household and potentially smaller effects in group settings because of deep-seated traditional norms.

We document three key findings: 1) information delivery increased knowledge of antenatal care and IFA consumption across all treatments immediately after the intervention,

2) private information to the pregnant daughter-in-law alone or with their mother-in-law results in an increase in ANC visits in the short-term whereas we find no effects of the group information treatment in the short-term, and 3) information interventions improved post-delivery maternal and infant health outcomes subsequently. [1]

[1](Chawla (2023)). This chapter includes results from the complete sample, Phase 5 for the midline and Phases 3-5 for the endline, thus substantially updating the previous version of this work in (Chawla (2023)). Additionally, it incorporates control group villages that were excluded from previous analyses. I present several models for the results, including one featuring lasso-selected controls. Furthermore, this version constructs the knowledge index using Anderson (2003) and provides midline and endline results for all outcomes where data was collected.

3.1 Introduction

Maternal mortality is the leading cause of daily deaths of almost 810 otherwise healthy women of childbearing age worldwide (WHO (2024)). India is one of 10 countries that account for 60 percent of global maternal deaths, stillbirths, and newborn deaths (UNICEF (2023)). In recent years, India has made considerable progress in improving its maternal mortality rate (MMR) NFHS (2016a)). However, the MMR still remains high at 113 per 100,000 live births in 2016-2018 and is a significant policy priority. Significant disparities in deaths persist across the country, with a large proportion of deaths concentrated in the rural regions of poorer states (NFHS (2016a)). Globally and in India, the three leading causes of maternal mortality are postpartum hemorrhage, sepsis, and hypertensive disorders such as preeclampsia and eclampsia. Several studies have demonstrated that adequate antenatal care (ANC) can easily prevent these conditions (Gupta et al. (2010); Kassebaum et al. (2016); Meh et al. (2022); Montgomery et al. (2014); Peña-Rosas et al. (2015)). Despite the Indian government's provision of free and accessible antenatal care, the number of antenatal visits remains extremely low.

In this paper, we study two questions: Is it possible to increase perinatal health behaviors, in particular the number of ANC visits and the consumption of iron and folic acid (IFA) tablets, by providing health information to either the daughter-in-law or mother-in-law in the household? In India, where social norms play a significant role, does take-up of health behaviors differ when information is provided individually (in private) or in groups (in public)?

We investigate the role of the mother-in-law and social norms together for three distinct reasons. First, sample survey data from India shows that women who are not as involved in household decision-making, travel unaccompanied to healthcare facilities, and whose families are unlikely to think ANC visits are important are less likely to make these visits (Ogbo et al. (2019)). Second, India's patrilocal society provides a unique opportunity to study how other household members, particularly the mother-in-law, influence health, mobility, and resource decisions for young women (Allendorf (2017); Anukriti et al. (2019, 2022); Banerji et al. (2023); Ghosh and Thornton (2024); Khanna and Pandey (2020); Varghese and Roy (2019)). Finally, social learning or learning from peers is especially important in low and middle-income countries (LMICs), where limited access to health information leads individuals to rely heavily on learning from others for decision-making (Bursztyn et al. (2018); Bursztyn and Jensen (2017); Chandrasekhar et al. (2018); Karing (2019)). These networks play a crucial role in maintaining social norms or promoting behavior change.

To investigate whether we can increase ANC visits through information, we conduct a randomized controlled trial in 249 villages across three districts in the central Indian state of Madhya Pradesh between 2022 and 2023. Madhya Pradesh has one of the highest MMRs of states in India, 173 deaths per 100,000 making this a context where marginal improve-

ments in ANC visits, could improve health outcomes. In our experimental design, we vary whether health information on the importance of completing ANC visits is provided to only the daughter-in-law (only DIL treatment) or to both the daughter-in-law, and the mother-in-law (DIL+MIL treatment). We also vary whether the information is provided in private (Individual treatment) or in public setting (Group treatment). The study involves 2409 households across three districts. Our treatment provides health information on regularly going for ANC visits, and consuming IFA tablets to reduce the risk of anemia and birth defects. Previous pilot work as well as the baseline survey show that women either underestimate or have incorrect prior beliefs about the benefits of ANC, and the consumption of IFA tablets is associated with strong beliefs that they cause harm to the mother and baby due to their side effects. As a result, our treatment uses a counseling style script and our trainers spent time encouraging conversation and a discussion around priors about these behaviors. Our study also has a few other aspects: 1) to prevent mothers-in-law intervening during the 'Only DIL' treatments, we provided them placebo health information on COVID-19 to keep them engaged during the same time, 2) we offered all participants a flyer to sign to commit to attending an ANC and health information visit at the hospital immediately after the intervention; 3) Information effects tend to taper over time so we play an engaging recorded message to the participants during the midline as a reminder. Finally, we collect outcomes at two points in time: a midline survey approximately a month and a half after the initial intervention to measure short-term effects, and an endline survey after the participants have given birth to measure longer-term outcomes.

We measure three primary outcomes: ANC and IFA knowledge, and self-reported number of ANC visits completed, and IFA tablet consumption. We also consider the following secondary outcomes: post-intervention flyer signed, self-reported visit to the district hospital, pregnancy, birth and perinatal maternal and infant complications. From a policy perspective, we are interested in understanding whether involving the MIL improves ANC visits and IFA, and whether group or public settings are the best to disseminate health information, which is often the case in India.

We find immediate significant improvements at midline in ANC and IFA knowledge, measured by a standardized index, for both DILs and MILs in both Individual and Group treatments. The effects were higher in magnitude for DILs in the Group treatment compared to Individual, although this difference is not significant. We see a 0.28 standard deviation (sd) increase in knowledge, closely followed by the MIL. However, at endline, the individual treatment effects strengthened, whereas the group treatment effects decreased for DILs but remained stable for MILs. Cross-randomized treatment arms showed similar trends, with DILs in the individual treatment arms displaying even stronger knowledge gains at endline. Interestingly, MILs exhibited knowledge increases even in treatment arms where they were not directly treated, suggesting knowledge transfer from DILs. Overall, DILs learned more when grouped with other DILs, while MILs showed significant knowledge gains even when not included in the treatment, providing evidence of intergenerational bargaining in

the household.

For ANC visits and IFA tablet consumption, the Individual treatment led to a quick increase in ANC visits at midline, significantly outperforming the Group treatment. However, by endline, the Group treatment caught up, suggesting that Individual treatment boosts short-term gains while Group can take time to effect changes. For IFA tablet consumption, the Group treatment showed significant gains at both midline and endline, indicating that peer effects play a crucial role in overcoming initial resistance to IFA consumption. The Individual treatment, however, did not produce significant changes in IFA consumption, reinforcing the importance of peers in health behavior change. Overall, we see more improvements in behavior when the MIL is involved in addition to the DIL and the least when DILs are treated on their own suggesting the decision-making power of the MIL in the household and the lack of agency of the DIL.

Involving MILs in the intervention significantly increases health-seeking behaviors. While there were no significant differences between the Group and Individual treatments in signing the flyer, the Group treatment showed a tendency for fewer flyers signed but more hospital visits. When further breaking down the results, daughters-in-law in both the Group and Individual treatments with their mothers-in-law were significantly more likely to visit the district hospital for additional training than daughters-in-law given information in the absence of mothers-in-law or peers. Notably, the Group treatment with both daughters-in-law and mothers-in-law resulted in the highest likelihood of hospital visits, despite being the least likely to sign the flyer immediately after the training, when compared to daughters-in-law given information alone, in the absence of the mother-in-law or peers. These findings highlight the positive impact of involving mothers-in-law in promoting health-seeking behaviors, and are also suggestive of a social norm dynamic.

Finally, we observe significant differences in perinatal complications at endline. DILs in the Individual treatment, both with and without the MIL, experienced significantly fewer complications after delivery and with the infant. Conversely, the Group treatment involving both the DIL and the MIL saw more complications during pregnancy. This group also had the fewest ANC visits at midline, suggesting a relationship between seeking ANC earlier in pregnancy and better health outcomes. This study makes four significant contributions. First, to our knowledge, it constitutes the first field experiment designed to test the impact of the relationship between the daughter-in-law and mother-in-law on women's health decisions. Existing studies have shown that this intergenerational dynamic can play out in two ways: co-residence with the mother-in-law can positively affect better sharing of household work (Khanna and Pandey (2020)), improved iron supplementation during pregnancy (Varghese and Roy (2019)), enhanced mental health during the postpartum period with a better relationship (Chandran et al. (2002); Gausia et al. (2009)), and increased likelihood of using antenatal care (Allendorf (2010)). Conversely, the mother-in-law could limit young women's mobility and access to peer networks, impact their reproductive health-seeking be-

havior (Anukriti et al. (2019, 2022)), or lead to power struggles over finances (Gram et al. (2018)). These studies are based on correlations or quasi-experimental analyses (Anukriti et al. (2019); Banerji et al. (2023); Ghosh and Thornton (2024); Khanna and Pandey (2020)), with no consensus on the direction and impact of the relationship on decision-making. Our findings provide new evidence on this relationship: DILs tend to take-up better health-seeking behaviors when their MILs are involved. This effect is more salient at the Individual treatment level. Second, this study contributes to the extensive literature on intrahousehold decision-making, which has largely focused on spousal bargaining within a nuclear family structure. Even within studies on spousal bargaining, limited attention has been given to understanding health decision-making, with the exception of fertility decisions (Ashraf et al. (2017, 2020)) and contraception adoption (Ashraf et al. (2014)). Intrahousehold decision making across generations holds particular importance in LMICs where multiple generations reside in the same household. This study significantly extends the existing empirical evidence on household decision-making to include intergenerational decision-making, especially regarding health decisions.

Third, we contribute to the growing literature on social norms, signaling, and peer effects in economics. Previous literature has documented the effect of social norms in educational settings (Bursztyn et al. (2019, 2018); Bursztyn and Jensen (2015, 2017)), as well as the rigidity of traditional social norms due to social image concerns (Haenni and Lichand (2021)). Building on the seminal social signaling models by (Benabou and Tirole (2011); Bénabou and Tirole (2006)), recent empirical literature has shown that individuals in limited information settings are concerned with signaling, and their utility often depends on the expectations that others form about their type based on actions they or members of their network take (Bursztyn et al. (2018); Karing (2019)). Chandrasekhar et al. (2018) and Banerjee et al. (2019) also provide evidence on how the social stigma of seeking information can inhibit social learning. We contribute to this literature by experimentally varying whether the knowledge of information delivery is public or private. In line with the literature, we find evidence consistent with the hypothesis that social image concerns inhibit the take-up of ANC visits, and consumption of IFA tablets in the short-run when information provision occurs in a group or public setting.

Lastly, we contribute to the literature on health information campaigns. A lack of information on health risks and benefits is a critical factor behind the underinvestment in preventative healthcare. Few studies have shown the causal link between simple information, reducing risky health behaviors, and remedial health-seeking (Dupas (2011); Jalan and Somanathan (2008); Madajewicz et al. (2007)). However, information impacts different individuals in different ways. Information has the desired impact when targeted to the right person Kremer and Miguel (2007)) or when differences in incentives within the household or levels of decision-making authority are considered (Ashraf et al. (2017); Björkman-Nyqvist et al. (2023); Nyqvist and Jayachandran (2017)). Additionally, the effectiveness of information can vary drastically depending on whether learning from others is possible (Kremer and

Miguel (2007); Leonard et al. (2009)). We contribute to this literature by: (1) providing information about a preventative health behavior like antenatal visits, which can have high-stakes negative consequences; (2) targeting the information to specific household members to understand the impact of the recipient on health behaviors; and (3) providing information in the presence of peers, thereby studying the effect of social learning and norms on health-seeking behavior.

3.2 Context and Setting

3.2.1 Antenatal care in India

ANC is defined as care provided by a skilled health professional focused on the mother and the baby throughout pregnancy. The typical components of antenatal care in India include identifying risk factors, management of pregnancy-related health conditions and health education. The government of India defines complete antenatal care as at least 4 antenatal visits with the first visit being in the first trimester, three tetanus typhoid injections, and a minimum of 100 iron folic acid tablets taken throughout the pregnancy. All antenatal visits in India are provided free of cost. In addition, Village Health and Nutrition Day is organized once every month in every village to provide maternal and child healthcare services within the village.

Obstetric hemorrhage, pregnancy-related infection, and improper monitoring and underestimating the importance of warning signs hypertensive disorders are the main drivers of maternal deaths in India (Gupta et al. (2010); Kassebaum et al. (2016); Meh et al. (2022); Montgomery et al. (2014)). Regular antenatal check-ups allow for the opportunity to diagnose these disorders and provide treatment promptly. In addition, pre-existing conditions like anemia which worsen during pregnancy and exacerbate postpartum bleeding increase the proportion of hemorrhage-related deaths in poorer states and rural areas. The prevalence of iron deficiency anemia in pregnant Indian women is among the highest in the world and untreated anemia can have significantly adverse birth outcomes for mothers and newborns (Tandon et al. (2018)). Indian women, particularly in rural areas, are unable to meet the iron demands of pregnancy through diet alone. As a result, along with communication of nutritional requirements, the World Health Organization (WHO) recommends all pregnant women be given 30-60 mg of elemental iron per day along with 2.8 mg of folic acid. Thus, an important component of antenatal care visits in India is the provision of iron folic acid (IFA) supplements free of cost to all pregnant women.

3.2.2 Setting

In this study, we focus on the central state of Madhya Pradesh which is a large state in central India with approximately 40 percent of its population living in poverty. The state

is administratively divided into 52 districts with 51,527 villages. We chose to conduct the study in three districts in the state: Sagar, Panna, and Chhattarpur. We selected these districts as they have a higher burden of adverse maternal health outcomes, are a priority for our implementing partner, and state government. Table 3.1 shows health indicators for Madhya Pradesh, and the sample districts. A little more than half of the state's pregnant women reported going for four ANC visits with lower proportions for the districts (35.9, 36.9, and 30.9 respectively) in the study sample. We also see that close to a majority of the sample is anemic but consumption of IFA tablets remains low.

3.3 Conceptual Framework

This paper aims to (1) understand how providing counseling-style health information on prenatal best practices to DILs and their MILs can improve health outcomes for mothers and infants and (2) examine how participation in social learning through groups affects the adoption of health behaviors by DILs and MILs. Additionally, we seek to unpack the inter-generational decision-making dynamic between the DILs and the MILs in a setting where the relationship can be restrictive and adherence to norms is high.

The intervention delivers information on two important maternal health practices: the benefits of regular antenatal check-ups, and taking iron folic acid supplements to reduce the risk of anemia during pregnancy. We deliver this information in a counseling-style (see Appendix A1) to encourage conversation and cooperation between the DIL and MIL. Our motivating hypothesis is that DILs and MILs lack information about the benefits of ANC and IFA consumption, and that prior beliefs and norms may limit improvements in these outcomes. Previous pilot work has shown that women are either unaware or underestimate both the benefits of ANC and the risks involved in not receiving appropriate care during pregnancy.

By providing information to individuals alone versus in groups, we aim to understand better how the joint provision of information to informal networks outside the household can influence the DIL's agency and health-seeking behavior. If the MIL has no prior beliefs, we expect to see a strong effect of the group treatment on the take-up of ANC visits by the MIL. Given the DIL's limited access to a social network in the village (Anukriti et al. (2019)), we expect the effect on the DIL to be positive but similar to the effect when only the DIL is informed individually. When the MIL holds strong prior beliefs and receives information (e.g., IFA-related information), we expect one of two outcomes: either a change in norms through social learning or a stronger adherence to norms due to social pressure to maintain the status quo.

Based on this, we have the following independent hypotheses:

- We anticipate a greater treatment effect when the MIL is treated along with the DIL as the literature suggests that the MIL exerts more influence in household decision-making *(Only DIL < DIL and MIL)*
- If neither the DIL nor the MIL have strong priors, we predict they will update their beliefs, resulting in a treatment effect. Otherwise, no effect is expected.
- If the MIL has no strong priors, we expect to see a higher effect of the group (public information) *(Group > Individual; DIL and MIL > Only DIL)*
- If the DIL has no strong priors, we expect group (public information) to have a higher effect *(Group + Only DIL > Individual + Only DIL)*
- If the MIL has strong priors, we expect the DIL to align with the MIL's decision, but we cannot predict ex-ante which way the effect would go *(Only DIL < DIL and MIL; Group >, < or = Individual).*

3.4 Experiment: Design and Implementation

We designed our experiment to explore the most effective way to convey health information to pregnant women in environments with particularly low agency. Central to the design is the observation that providing information to daughters-in-law (DILs) alone might not achieve the desired effect of increasing preventative care during pregnancy if social norms and mothers-in-law (MILs) play a dominant role in household decision-making. Our ultimate goal was to determine the most influential recipient of the information and the optimal mode of delivery.

3.4.1 Treatments

All of our experimental treatment arms involved delivering important health information on the importance of ANC, and leveraging support from household members, particularly the MIL. Specifically, our intervention focused on the following: 1) benefits of ANC and the minimum number of visits recommended; 2) availability of free care and place to find care; 3) the risk of anemia during pregnancy; and 4) common misconceptions about iron tablets. In all treatment arms, DILs were also encouraged to talk to their mothers-in-law about this information and ask her for support during the pregnancy. The treatment arm involving DILs and MILs together encouraged asking questions and discussion between the DIL and her MIL (B.2). Finally, participants in each treatment group were provided a flyer to sign at the end of the intervention, committing to attending an in-hospital training.

The treatments are as follows:

1. Control group: The control group was a pure control group; they did not receive any intervention.

2. Individual + Only DIL ($T_{I:DIL}$): only the DIL received the health information, which was provided at her home. To maintain the privacy of the information delivery from the MIL, the MIL received a placebo training on COVID-19-related safety.

3. Individual + DIL and MIL ($T_{I:DIL+MIL}$): The DIL and MIL received the health information at their home. The information was given to them together, at the same time, and the script encouraged conversation and questions.

4. Group + Only DIL ($T_{G:DIL}$): The DIL was invited to a village group meeting, and received the health information there, in the presence of other DILs from the village. To ensure participation, the MILs were also invited but received the place COVID-19 related training in the presence of other MILs. All group meetings encouraged conversation and questions.

5. Group + DIL and MIL ($T_{G:DIL+MIL}$): The DILs and MILs were invited to a village group meeting, and received the health information there, in the presence of other DILs and MILs from the village. All group meetings encouraged conversation and questions.

3.4.2 Power calculations

We computed the sample size for the impact of the treatment on the number of ANC visits using the NFHS 2015-16 data. We calculated the mean (2.31 visits), standard deviation (3.1), and intraclass correlation coefficient (0.285) for ANC visits using data from our three sample districts. We also assumed a cluster size of 10 pregnant women per village. Ex-ante, our budget allowed us to work in a maximum of 400 villages, so we calculated power based on those estimates. We divided these equally across the pooled and cross-randomized treatment arms. This allocation gave us a maximum of 1000 DILs and 1000 MILs per pooled treatment, resulting in a maximum total sample size of 4000 DILs and 4000 MILs. With this design, we achieved a power of 0.8 to detect a minimum detectable effect (MDE) of 0.73 visits (cluster size 10) or 0.80 visits (cluster size 5) in the pooled treatment groups versus the control group and an MDE of 0.9 visits (cluster size 10) or 0.98 visits (cluster size 5) in the cross-randomized treatment arms versus the control group.

3.4.3 Sample size and randomization

We selected 618 initial villages in our sample districts from the 2011 district-wise census. We chose villages based on the following criteria: 1) 300-700 households per village; 2) a maximum distance of 10 kilometers from a health facility; and 3) the presence of public transport in the village. We conducted an initial scouting survey in these 618 villages to collect a roster of pregnant women from the community health workers and gather village-level characteristics. Our inclusion criteria for the baseline survey required villages to have more than five pregnant women, resulting in a final list of 426 villages. For ease of implementation, we conducted the study in five phases. We randomized the 426 villages into these five phases.

In each phase, we implemented a baseline survey, the intervention, a midline survey, and an endline survey (see 3.1 for details).

We collected baseline survey data from all consenting daughters-in-law and mothers-in-law after applying the study's inclusion criteria: 1) DILs had to be less than seven months pregnant at the time of the survey; and 2) DILs had to reside with their MILs on a permanent basis. We conducted the baseline survey in person, simultaneously surveying both the DIL and MIL. The survey collected data on demographics, pregnancy and fertility history, knowledge of preventative care during pregnancy, and beliefs in social norms. Additionally, the survey included questions to elicit the relationship between the DIL and the MIL.

We randomized the participants into treatments after the baseline survey. Table B.1 shows the phase-wise villages selected for randomization after applying all inclusion criteria. The total sample randomized at baseline consists of 281 villages and 2409 households. We stratified our sample by district, sub-district, number of pregnant women at baseline, total number of households, and distance to the nearest health center. The randomization was conducted in Stata 16, using the *randtreat* command. We randomized at the village level and then at the household level. First, villages were randomized into a control arm, a group treatment, and an individual treatment. We assumed an unequal cluster size, ranging between 6 and 26 households in a village. We also assigned unequal treatment fractions, with the control group having less villages than the Group and Individual treatment. Next, we randomized households within each treatment village into the Only DIL and the DIL and MIL treatments. This randomization assumed equal treatment fractions. Table B.3 tests baseline covariates between the control group and the treatment arms, and then across the treatment arms. Columns 1-10 present the mean and standard deviation by covariate in the control and each treatment, while columns 11-18 present p-values of pairwise comparisons of differences in means. Of the 656 comparisons, 5.64 percent have a p-value below 0.1 and 8.84 percent have a p-value below 0.05.

We delivered the intervention described in the previous section within three weeks after the baseline in all treatment groups. One and a half months after the intervention, we conducted an in-person midline survey for the entire sample. The midline survey was brief and collected only primary outcomes. At the end of the midline survey, all treated participants received a 'reminder' message, which included listening to a short audio clip of a conversation between a community health worker and a doctor about the importance of ANC, warning signs during pregnancy, and institutional birth.

We conducted endline surveys within a month after delivery. Given the range of gestational ages (2 to 6 months), the endline survey followed the timing of births rather than the phases. Since delivery dates varied among households in a village, we implemented the endline survey over the phone. The endline survey collected the same data as the baseline survey and included post-delivery outcomes, volume of conversations, and feedback on the

health information intervention.

3.4.4 Outcomes

We consider three main outcomes of interest at two points in time, the midline and the endline: 1) knowledge of ANC and IFA; 2) number of ANC visits completed; and 3) number of IFA tablets consumed. Additionally, we examine secondary outcomes measured once during the study period: 1) flyer signed after the intervention (measured at the time of intervention); 2) district hospital visits for additional pregnancy-related sessions; and 3) pregnancy, birth, and infant complications (measured at endline).

We construct a standardized weighted ANC and IFA knowledge index following Anderson (2008)). The index components include indicators for correctly identifying 1) the importance of ANC for detecting maternal health complications, 2) the importance of ANC for detecting fetal complications, 3) the importance of ANC for early intervention, 4) the importance of iron in preventing anemia; and 5) that beliefs about IFA side-effects are incorrect.

We then consider the number of ANC visits completed and the number of IFA tablets consumed as self-reported continuous outcomes, winsorized at the 95th percentile to control for outliers. These outcomes enable us to measure actual changes in preventative health behaviors.

By offering participants the option to sign a flyer, we provide them with a choice to commit to health-seeking, thus allowing us to measure their immediate response to the intervention. Similarly, self-reported visits to the district hospital help us measure further health-seeking behavior. Finally, we use self-reported pregnancy complications (pre-eclampsia, anemia, gestational diabetes, placenta previa, bleeding, thyroid-related disease, and infection), birth complications (pre-eclampsia, eclampsia, bleeding, infection, fetal distress, meconium aspiration, stillbirth, and preterm labor), post-delivery complications (unable to breastfeed, excessive bleeding, and infections), and an indicator if the infant was sick after delivery. These allow us to measure the impact on health in the perinatal period.

3.5 Estimation strategy

We begin by examining which delivery mechanism (group vs. individual) led to changes in our primary outcomes. To estimate this effect, we present intent-to-treat (ITT) estimates, and our main estimation equation for the pooled treatment is:

$$Y_{iv} = \alpha + \beta_1 T_{G_{iv}} + \beta_2 T_{I_{iv}} + \gamma X_v + \lambda X_i + \theta_s + \epsilon_{iv}$$

where Y_{iv} represents the ANC and IFA knowledge index, number of ANC visits, or number of IFA tablets consumed for respondent i in village v. $T_{G_{iv}}$ and $T_{I_{iv}}$ are treatment indicators for Group and Individual treatments, with the control group as the reference group.

Similarly, we consider which information recipient (only DIL vs. DIL and MIL) matters more for our outcomes. We present a similar equation to 3.5:

$$Y_{iv} = \alpha + \beta_1 T_{I:DIL_{iv}} + \beta_2 T_{I:DIL+MIL_{iv}} + \beta_3 T_{G:DIL_{iv}} + \beta_4 T_{G:DIL+MIL_{iv}} + \gamma X_v + \lambda X_i + \theta_s + \epsilon_{iv}$$

where $T_{I:DIL_{iv}}$ is a treatment indicator for belonging to the cross-randomized arm T1: Individual + Only DIL, $T_{I:DIL+MIL_{iv}}$ is an indicator for T2: Individual + DIL and MIL, $T_{G:DIL_{iv}}$ is an indicator for T3: Group + Only DIL, and $T_{G:DIL+MIL_{iv}}$ is an indicator for T4: Group + DIL and MIL.

To increase the precision of our estimates, we control for village-level covariates (X_v) and individual-level covariates (X_i) selected using post-double selection LASSO (see Chernozhukov et al. (2018)). θ_s denotes the strata fixed effects.

For all specifications, we estimate models using ordinary least squares (OLS), and standard errors are clustered at the village level. We also report p-values of F-tests to check if the coefficients in both 3.5 and 3.5 are different for our comparisons of interest. We correct for multiple hypothesis testing and present sharpened False Discovery Rate (FDR) adjusted q-values (Anderson (2008)).

3.6 Ethics review

This study received approval from the ACE Ethics Committee
(DCGI Reg. No. ECR/141/Indt/KA/2013/RR-19) based in Bangalore, India, and the Institutional Review Board (IRBs) at the University of California, Berkeley (2020-03-13149). All participants consented in their local language. The trial is registered on the AEA RCT Registry. There were no significant changes between the pre-analysis plan and the results presented here, except the inclusion of the following secondary outcomes: 1) flyer signed, and 2) district hospital visited.

3.7 Results

3.7.1 Sample description, balance, and attrition

Table B.4 and B.6 present differences in baseline characteristics of the midline and endline samples for the DIL. On average, DILs in both samples are approximately 23 years old, have slightly over 8 years of schooling, belong to non-general social categories, and less than 20

percent work outside the home. Nearly half of the DILs have been pregnant, and approximately 40 percent have had a previous live birth. At baseline, DILs are between 4 and 5 months pregnant and have completed around one ANC visit before any intervention. ANC and IFA knowledge are high, with approximately 70 percent answering knowledge questions correctly. DILs in our sample live in a very norm-based environment characterized by a restrictive relationship with their MILs. Over 80 percent of DILs need permission from their MILs to visit their maternal home, make purchases, visit friends, or meet with the community health worker. About half the DILs report their MILs limit contact with female friends, get upset with disagreements, and do not like discussing issues related to the DIL's health. Around 90 percent of DILs agree that adherence to norms is important, and only 10 percent believe women should be able to travel independently to health centers.

In addition to descriptive data, Tables B.5 and B.7 also present tests for baseline covariates for the midline (endline) samples. Similar to Table 2a, of 656 pairwise comparisons, 5.64 (41.11) percent have a p-value below 0.1, and 7.77(5.64) percent have a p-value below 0.05.

The overall attrition rate for DILs between baseline and midline was 17.4 percent and the attrition rate between baseline and endline was 23.5 percent. We expected a higher attrition at endline ex-ante as it is harder to track DILs and MILs over the phone, compared to the midline conducted in person. Table B.8 shows the differential attrition for DILs and MILs at midline. The attrition rate was significantly lower for DILs in all treatments, except for TI:DIL+MIL. The attrition rate for MILs was only lower in $T_{I:DIL}$, and $T_{G:DIL+MIL}$. DILs whose household heads were either their MIL or father-in-law, were Hindu or had an older husband were more likely to attrit at midline. Upper caste category and correct knowledge of ANC visits were less likely to attrit. All other covariates do not appear to explain attrition across treatments. Table B.9 shows the attrition rates at endline, where we did not observe significant differential attrition. To account for differential attrition, we include a set of results with inverse probability weights (IPW) for robustness. However, we report results only from model (2), which includes strata fixed effects and lasso-selected controls. For the main results, we excluded 7 villages from the midline and endline samples as they did not receive any treatment due to implementation issues. We also excluded 14 control villages from the endline data that accidentally received the reminder message at midline due to surveyor oversight. Tables B.5 and B.7 present samples that account for these changes. We now report the main empirical results of our specifications. In the following section, we describe the results from the model (2) of the tables, which includes fixed effects and baseline covariates. The results are divided into three categories: 1) knowledge of ANC and IFA, 2) number of ANC visits and IFA tablet consumption, and 3) perinatal health outcomes.

3.7.2 ANC and IFA knowledge at midline and endline

Table 3.2 presents the results on knowledge as measured by the ANC & IFA knowledge index described in section 3.4.4. We show knowledge changes for both the DIL and the MIL at midline and then at endline.

Panel A shows the estimates for specification 3.5, the pooled treatment arms. We see the health information intervention is immediately effective for the DILs and the MILs at midline, with gains in the ANC & IFA knowledge index of 0.28 sd ($p = 0.001$) for DILs and 0.23 sd ($p = 0.037$) for MILs in the Group treatment when compared to control. The individual treatment shows similar effects, with an increase of 0.20 sd ($p = 0.014$) for DILs and 0.21 sd ($p = 0.052$) for MILs when compared to control. These effects remain significant for DILs accounting for the false discovery rate (FDR). Improvements are fairly similar between the two treatments and we do not observe significant differences between them ($p = 0.157$). Looking at the same specification,when comparing point estimates between midline and endline, we see that the effects get stronger compared to control for DILs and MILs in the Individual treatment. However, in the Group treatment, the effect remains unchanged for MILs, and decreases compared to control for DILs, suggesting some frictions in aggregation of knowledge after the intervention and reminder.

Panel B presents the estimates for specification 3.5, the cross-randomized treatment arms compared to the control group. We observe similar significant effect sizes as the pooled arms for each of the treatments, with the exception of the MILs knowledge in $T_{I:DIL+MIL}$ arm. At endline, the effects are stronger for DILs in $T_{I:DIL}$ and $T_{I:DIL+MIL}$ (0.38 sd ($p = 0.000$) and 0.31 sd ($p = 0.005$) respectively) compared to control. However, at endline we see a reduction in effects compared to control for DILs in $T_{G:DIL}$, and $T_{G:DIL+MIL}$. MILs in $T_{I:DIL+MIL}$ catch up at endline compared to control (0.35 sd ($p = 0.001$)). These effects remain significant for DILs accounting for the FDR. It is worth noting, the effect of $T_{G:DIL+MIL}$ is significant (compared to control) with the inclusion of inverse probability weighting. An interesting finding of these results is that we see increases in knowledge for MILs even in treatment arms where they were not treated.

When comparing treatment arms, we find that DILs learn more when grouped with other DILs than on their own ($T_{G:DIL} > T_{I:DIL}$; p=0.085), at midline and endline, an effect that remains significant account for the FDR. MILs at endline, show an increase in knowledge even when not included in treatment, indicating a transfer in knowledge from DILs ($T_{G:DIL} < T_{I:DIL}$; p=0.045). Finally, DILs treated with their MILs have significantly more knowledge when treated individually compared to groups ($T_{G:DIL+MIL} < T_{I:DIL+MIL}$).

3.7.3 Number of ANC visits and IFA tablet consumption

Table 3.3 presents the results for ANC visits and IFA tablets consumption at midline and endline, as reported by DILs.

Panel A displays the pooled results. At midline, DILs in the Individual treatment have 0.22 more ANC visits compared to control (p=0.007), indicating quick take-up. In contrast, Group treatment DILs show no significant gains. Notably, Individual treatment DILs have significantly more than Group treatment DILs (p=0.027). These effects remain significant accounting for the FDR. However, at endline, Individual treatments DILs no longer have significant gains, whereas Group treatment DILs catch up, with 0.18 more visits (p=0.079). This suggests that Individual treatment improved short-term gains, which Group treatment improved long-term gains. However, this effect is not significant at traditional levels of significance for the FDR.

Panel A also presents the pooled results for IFA tablet consumption. Despite a smaller midline sample size due to surveyor error, we observe significant results. Individual treatment DILs show no effects on IFA consumption, whereas Group treatment DILs exhibit modest but significant gains (11.38 more tablets, p=0.064). This aligns with our hypothesis that IFA consumption is associated with strong priors, and peer effects drive the differences between treatment arms (p=0.027). These effects remain significant accounting for the FDR. At endline, Individual treatment DILs remain unchanged, while Group treatment DILs maintain their gains (9.21 more tablets, p=0.048). However, this effect is not significant at traditional levels of significance for the FDR.

Panel B presents the estimates for 3.5, comparing the cross-randomized treatment arms to the control group. We observe significant effects for $T_{I:DIL}$ and $T_{I:DIL+MIL}$ at midline, with $T_{I:DIL+MIL}$ having significantly more visits than TI:DIL ($p = 0.003$). These effects remain significant accounting for the FDR. However, at endline $T_{I:DIL}$ and $T_{I:DIL+MIL}$ no longer show significant gains. Interestingly, $T_{G:DIL+MIL}$ now has 0.21 more visits than control, and is significant, suggesting information seeking and aggregation over time. For IFA consumption, we observe increases of 10-11.5 tablets for $T_{G:DIL}$ and $T_{G:DIL+MIL}$, although only $T_{G:DIL}$ is significant. Finally, at endline we see significant gains for both$T_{G:DIL}$ and $T_{G:DIL+MIL}$ with effect sizes ranging from 8.4-9.9 more tablets, and $T_{G:DIL+MIL} > T_{G:DIL}$ ($p = 0.068$). However, this effect is not significant at traditional levels of significance for the FDR.

3.7.4 Flyer signed and district hospital visited

Table 3.4 presents results for two health-seeking outcomes: 1) flyer signed (measured at midline) and 2) district hospital visit (measured at endline). Panel A shows the results for the pooled treatment arms, with the Individual treatment as the reference group, as the Control arm was not offered the flyer or the district hospital training. We see no significant effects between the two groups, but note that the signs are opposite. The Group treatment

is less likely to sign the flyer compared to the Individual treatment but more likely to visit the district hospital, though these differences are not significant.

In Panel B, DILs in $T_{G:DIL+MIL}$ and $T_{I:DIL+MIL}$ are significantly more likely to visit the district hospital for additional training compared to DILs in $T_{I:DIL}$ (p=-0.030 and 0.049). However, DILs in $T_{G:DIL+MIL}$ s are significantly more likely to visit the hospital compared DILs in $T_{I:DIL+MIL}$. Interestingly, $T_{G:DIL+MIL}$ is the only treatment less likely to sign the flyer right after the training. One clear takeaway from these results is that involving the MIL in the intervention leads to an increase in health-seeking behaviors, such as actual visits to the hospital.

3.7.5 Maternal and infant complications

Table 3.5 displays the results for perinatal complications at endline, reported by the DIL. In Panel A, we see that Individual DILs experiences significantly lesser post-delivery and infant-related complications than the control (p=0.029 and 0.024) and Group DILs (p=0.000). We also see that Group DILs experienced a higher proportion of pregnancy-related complications compared to control (p=0.061) and the Individual DILs (p=0.011).

In Panel B, we see that post-delivery and infant-related complications are significantly lower for $T_{I:DIL}$ and $T_{I:DIL+MIL}$ and $T_{I:DIL} < T_{I:DIL+MIL}$. We also observe that DILs in TG:DIL+MIL experienced more pregnancy complications compared to control. These results closely follow the patterns of the result for ANC visits, and are indicative of a positive relationship between preventative pregnancy care and postnatal complications for mothers and infants.

3.8 Discussion

In this paper, we analyze the effect of providing important maternal health information to DILs and MILs in a public or private setting on preventative health seeking behavior, in particular on the number of antenatal care visits, and consumption of IFA tablets. In contrast to previous literature on the effect of information on health-seeking behavior, our study sheds light on a novel dynamic within the household, the role of inter-generational decision-making on maternal health decisions. Our results show a large increase in ANC and IFA for all treatments and a significant increase in the number of antenatal care visits, and IFA tablets consumed, in the short and long run. We also see a positive effect on perinatal health outcomes like post-delivery complications and infant health. The results are consistent with the hypotheses that: 1) mothers-in-law have considerable say in the health decisions of young married women in India; 2) norms and concerns about social image prevent mothers-in-law from allowing their daughters-in-law to seek more care during pregnancy, at least in the short run. The study provides strong motivation to further explore the role of the mother-in-law

in health decision-making. It opens up avenues for future research to understand how adherence to norms can be reversed to improve health outcomes (as well as possible spillovers).

The main contribution of our study is to shed light on a critical inter-generational dynamic across rural India when young married women co-reside with their mothers-in-law. Many health information campaigns focus on providing information to young married women, pregnant women, or new mothers. It is equally beneficial to target health information to other household members, particularly the mother-in-law. In order to improve outcomes for such women, it is vital to understand the inter-generational bargaining dynamic in the household and use it to either provide information to key decision-makers or empower the young women to engage in bargaining. The findings of our study show that not only is it essential to take this household dynamic into account but how information is provided can also have significantly different results in the presence of social norms and conformity to them.

Table 3.1: State and district-wise maternal health indicators

	State: Madhya Pradesh	District 1: Sagar	District 2: Chhatarpur	District 3: Panna
Completed at least four antenatal care visits (%)	57.5	35.9	36.9	30.9
Pregnant women who are anemic (%)	52.9	55.0	68.3	63.4
Consumed iron and folic acid tablets for > 100 days during pregnancy (%)	51.4	34.4	27.1	29.9
Talked to a health worker in the past year (%)	28.2	23.0	17.8	21.7

Notes: Data presented here is from the most recent version of the National Family Health Survey (NFHS) 2015-16 which is a nationally representative sample survey from the Government of India.

Table 3.2: Daughter-in-law (DIL) and mother-in-law (MIL) ANC and IFA knowledge at midline and endline

	Midline						Endline					
	ANC & IFA knowledge index						ANC & IFA knowledge index					
	DIL reported			MIL reported			DIL reported			MIL reported		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Panel A. Pooled treatments												
Group	0.266***	0.281***	0.262***	0.270**	0.232**	0.271**	0.144	0.147	0.210**	0.236**	0.242***	0.244***
	(0.087)	(0.082)	(0.081)	(0.123)	(0.110)	(0.114)	(0.099)	(0.099)	(0.092)	(0.102)	(0.090)	(0.092)
p -value	0.002	0.001	0.001	0.030	0.037	0.019	0.148	0.141	0.024	0.022	0.008	0.008
q -value	[0.018]	[0.018]	[0.018]	[0.115]	[0.115]	[0.115]	[0.287]	[0.287]	[0.287]	[0.051]	[0.051]	[0.051]
Individual	0.177**	0.197**	0.184**	0.227*	0.210*	0.257**	0.347***	0.346***	0.454***	0.338***	0.371***	0.379***
	(0.082)	(0.079)	(0.076)	(0.119)	(0.107)	(0.110)	(0.105)	(0.105)	(0.097)	(0.109)	(0.099)	(0.099)
p -value	0.033	0.014	0.017	0.058	0.052	0.021	0.001	0.001	0.000	0.002	0.000	0.000
q -value	[0.050]	[0.050]	[0.050]	[0.150]	[0.150]	[0.150]	[0.017]	[0.017]	[0.017]	[0.001]	[0.001]	[0.001]
Control mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	1,246	1,244	1,150	1,309	1,309	1,197	1,844	1,844	1,702	1,977	1,835	1,835
p (Group=Individual)	0.124	0.157	0.185	0.658	0.808	0.870	0.005	0.005	0.000	0.227	0.099	0.090
q -value	[0.187]	[0.187]	[0.187]	[1.000]	[1.000]	[1.000]	[0.032]	[0.032]	[0.032]	[0.234]	[0.234]	[0.234]

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Panel B. All treatments

T1: Individual + Only DIL	0.145*	0.172**	0.157*	0.254**	0.254**	0.309***	0.377***	0.378***	0.487***	0.380***	0.399***	0.407***
	(0.086)	(0.084)	(0.082)	(0.120)	(0.113)	(0.118)	(0.105)	(0.105)	(0.098)	(0.110)	(0.100)	(0.099)
p-value	0.095	0.041	0.058	0.036	0.025	0.009	0.000	0.000	0.000	0.001	0.000	0.000
q-value	[0.093]	[0.093]	[0.093]	[0.093]	[0.093]	[0.093]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
T2: Individual + DIL&MIL	0.215**	0.239***	0.208***	0.195	0.190	0.214	0.316***	0.313***	0.423***	0.295***	0.346***	0.359***
	(0.087)	(0.083)	(0.078)	(0.147)	(0.132)	(0.137)	(0.110)	(0.110)	(0.101)	(0.111)	(0.104)	(0.105)
p-value	0.014	0.005	0.009	0.185	0.153	0.120	0.004	0.005	0.000	0.009	0.001	0.001
q-value	[0.032]	[0.032]	[0.032]	[0.350]	[0.350]	[0.350]	[0.032]	[0.032]	[0.032]	[0.011]	[0.011]	[0.011]
T3: Group + Only DIL	0.274***	0.288***	0.255***	0.277**	0.255**	0.300**	0.122	0.128	0.170*	0.228**	0.235**	0.241**
	(0.087)	(0.086)	(0.084)	(0.129)	(0.113)	(0.116)	(0.105)	(0.105)	(0.099)	(0.104)	(0.091)	(0.094)
p-value	0.002	0.001	0.003	0.032	0.025	0.010	0.247	0.226	0.088	0.029	0.010	0.011
q-value	[0.022]	[0.022]	[0.022]	[0.093]	[0.093]	[0.093]	[0.301]	[0.301]	[0.301]	[0.053]	[0.053]	[0.053]
T4: Group + DIL&MIL	0.258***	0.280***	0.257***	0.264*	0.227*	0.250*	0.164	0.163	0.246***	0.243**	0.259***	0.259***
	(0.095)	(0.092)	(0.089)	(0.137)	(0.130)	(0.135)	(0.101)	(0.101)	(0.094)	(0.105)	(0.094)	(0.095)
p-value	0.007	0.003	0.004	0.057	0.081	0.066	0.107	0.108	0.009	0.022	0.006	0.007
q-value	[0.022]	[0.022]	[0.022]	[0.208]	[0.208]	[0.208]	[0.286]	[0.286]	[0.286]	[0.048]	[0.048]	[0.048]
Control mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	1,246	1,244	1,150	1,309	1,309	1,197	1,844	1,844	1,702	1,977	1,835	1,835

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p (T1=T2)	0.784	0.894	0.973	0.887	0.783	0.619	0.455	0.520	0.171	0.732	0.532	0.682
q -value	[0.454]	[0.454]	[0.454]	[1.000]	[1.000]	[1.000]	[0.442]	[0.442]	[0.442]	[1.000]	[1.000]	[1.000]
p (T3=T4)	0.181	0.199	0.361	0.625	0.576	0.45	0.189	0.159	0.169	0.041	0.228	0.290
q -value	[0.187]	[0.187]	[0.187]	[1.000]	[1.000]	[1.000]	[0.287]	[0.287]	[0.287]	[0.520]	[0.520]	[0.520]
p (T1=T3)	0.044	0.090	0.148	0.819	0.999	0.926	0.002	0.002	0.000	0.087	0.045	0.049
q -value	[0.088]	[0.088]	[0.088]	[1.000]	[1.000]	[1.000]	[0.018]	[0.018]	[0.018]	[1.000]	[1.000]	[1.000]
p (T2=T4)	0.555	0.574	0.495	0.644	0.785	0.800	0.059	0.061	0.019	0.563	0.308	0.255
q -value	[0.440]	[0.440]	[0.440]	[1.000]	[1.000]	[1.000]	[0.232]	[0.232]	[0.232]	[0.697]	[0.697]	[0.697]
Strata fixed efffects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline covariates	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Inverse probability weights (IPW)	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: This table presents the results of the treatments on ANC and IFA knowledge, as reported by the daughter-in-law (DIL) and the mother-in-law (MIL) at midline and endline. Each column represents a separate regression. The outcome variable of interest is an ANC & IFA knowledge index. The index components are indicators for: 1) correctly identifying the importance of ANC for detecting maternal health complications; 2) correctly identifying the importance of ANC for detecting fetal complications; 3) correctly identifying the importance of ANC for early intervention; 4) correctly identifying the importance of iron in preventing anemia; 5) correctly identifying that beliefs about IFA side effects are incorrect. These variables were combined into an index using Anderson (2008) and standardized around the mean of the control group. Panel A shows the effect of the pooled treatments on the ANC & IFA knowledge index, where the treatment variable is 1 if the DIL or MIL belong to the group or individual treatment and 0 if they belong to the control group. Panel B presents results for the same outcome for all four treatments, where the treatment variable is 1 if the DIL or MIL belong to T1-T4 and 0 if they belong to the control group. We present three models for both participants: (1), (2), and (3). All models include strata fixed effects, and robust standard errors clustered at the village level are shown in parentheses. Model (2) also includes baseline covariates selected using post-double selection (Chernozhukov et al. (2018)), and model (3) includes inverse probability weights to account for differential attrition. Data was not collected for Phase 1 and 2 of the midline due to surveye error. We excluded 7 villages from the midline and endline samples as they did not receive the treatments, and 14 control villages from the endline sample only as they were given the treatment. We present sharpened False Discovery Rate (FDR) adjusted q-values (DIL and MIL outcomes, and midline and endline outcomes were grouped separately) to correct for multiple hypothesis testing (Anderson (2008)). *** p <0.01, ** p <0.05, * p <0.1

Table 3.3: Number of ANC visits and IFA tablet consumption at midline and endline

	Daughter-in-law (DIL) reported at midline						Daughter-in-law (DIL) reported at endline					
	Number of ANC visits			IFA tablet consumption			Number of ANC visits			IFA tablet consumption		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Panel A. Pooled treatments												
Group	0.010	0.026	0.011	10.799*	11.380*	10.014	0.180*	0.179*	0.203*	9.205**	9.214**	8.582*
	(0.092)	(0.089)	(0.090)	(6.118)	(6.090)	(6.161)	(0.102)	(0.102)	(0.110)	(4.635)	(4.629)	(4.822)
p -value	0.917	0.772	0.906	0.080	0.064	0.107	0.081	0.079	0.066	0.048	0.048	0.077
q -value	[0.454]	[0.454]	[0.454]	[0.094]	[0.094]	[0.094]	[0.244]	[0.244]	[0.244]	[0.232]	[0.232]	[0.232]
Individual	0.201**	0.220***	0.203**	-0.706	-0.722	-0.831	0.141	0.142	0.183	7.657	7.485	6.421
	(0.084)	(0.081)	(0.085)	(5.417)	(5.474)	(5.430)	(0.124)	(0.124)	(0.135)	(5.565)	(5.608)	(5.402)
p -value	0.017	0.007	0.018	0.897	0.895	0.879	0.258	0.254	0.178	0.170	0.184	0.236
q -value	[0.028]	[0.028]	[0.028]	[0.454]	[0.454]	[0.454]	[0.302]	[0.302]	[0.302]	[0.470]	[0.470]	[0.470]
Control mean	2.969	2.969	2.969	56.63	56.63	56.63	3.300	3.300	3.300	70.79	70.79	70.79
Observations	1,991	1,991	1,831	731	731	676	1,835	1,835	1,695	1,835	1,835	1,695
p (Group=Individual)	0.032	0.027	0.039	0.052	0.027	0.052	0.668	0.680	0.841	0.703	0.676	0.627
q -value	[0.028]	[0.028]	[0.028]	[0.066]	[0.066]	[0.066]	[0.470]	[0.470]	[0.470]	[0.470]	[0.470]	[0.470]

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Panel B. All treatments

T1: Individual + Only DIL	0.173*	0.196**	0.182*	0.705	0.452	0.603	0.091	0.094	0.092	9.966	9.845	9.637
	(0.092)	(0.090)	(0.093)	(5.977)	(5.916)	(5.846)	(0.121)	(0.120)	(0.130)	(6.145)	(6.170)	(6.034)
p -value	0.060	0.031	0.053	0.906	0.939	0.918	0.450	0.432	0.477	0.106	0.112	0.112
q -value	[0.067]	[0.067]	[0.067]	[0.402]	[0.402]	[0.402]	[0.442]	[0.442]	[0.442]	[0.286]	[0.286]	[0.286]
T2: Individual + DIL&MIL	0.233***	0.247***	0.226**	-2.279	-3.377	-4.156	0.196	0.195	0.278*	5.289	5.054	3.240
	(0.088)	(0.084)	(0.089)	(5.110)	(5.278)	(5.264)	(0.140)	(0.140)	(0.153)	(5.245)	(5.302)	(5.091)
p -value	0.009	0.004	0.012	0.656	0.524	0.432	0.163	0.167	0.070	0.314	0.342	0.525
q -value	[0.022]	[0.022]	[0.022]	[0.187]	[0.187]	[0.187]	[0.287]	[0.287]	[0.287]	[0.395]	[0.395]	[0.395]
T3: Group + Only DIL	0.100	0.117	0.074	11.363*	11.394*	9.825	0.151	0.152	0.171	8.457*	8.468*	8.480
	(0.094)	(0.093)	(0.094)	(6.065)	(5.915)	(5.928)	(0.106)	(0.105)	(0.112)	(4.882)	(4.872)	(5.283)
p -value	0.289	0.208	0.435	0.064	0.057	0.100	0.157	0.151	0.129	0.085	0.084	0.110
q -value	[0.192]	[0.192]	[0.192]	[0.178]	[0.178]	[0.178]	[0.287]	[0.287]	[0.287]	[0.244]	[0.244]	[0.244]
T4: Group + DIL&MIL	-0.079	-0.065	-0.051	10.279	10.312	8.942	0.210*	0.208*	0.239**	9.888**	9.896**	8.546*
	(0.098)	(0.094)	(0.095)	(7.165)	(7.016)	(7.169)	(0.110)	(0.109)	(0.117)	(4.703)	(4.702)	(4.816)
p -value	0.420	0.493	0.590	0.154	0.144	0.215	0.057	0.058	0.042	0.037	0.037	0.078
q -value	[0.415]	[0.415]	[0.415]	[0.093]	[0.093]	[0.093]	[0.232]	[0.232]	[0.232]	[0.209]	[0.209]	[0.209]
Control mean	2.969	2.969	2.969	56.63	56.63	56.63	3.300	3.300	3.300	70.79	70.79	70.79
Observations	1,991	1,991	1,831	731	731	676	1,835	1,835	1,695	1,835	1,835	1,695

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p (T1=T2)	0.003	0.003	0.035	0.830	0.827	0.863	0.375	0.403	0.301	0.558	0.559	0.983
q -value	[0.022]	[0.022]	[0.022]	[0.402]	[0.402]	[0.402]	[0.442]	[0.442]	[0.442]	[0.422]	[0.422]	[0.422]
p (T3=T4)	0.371	0.438	0.503	0.273	0.161	0.0958	0.18	0.199	0.031	0.077	0.068	0.027
q -value	[0.402]	[0.402]	[0.402]	[0.192]	[0.192]	[0.192]	[0.297]	[0.297]	[0.297]	[0.236]	[0.236]	[0.236]
p (T1=T3)	0.461	0.436	0.304	0.096	0.066	0.134	0.551	0.563	0.455	0.756	0.778	0.832
q -value	[0.402]	[0.402]	[0.402]	[0.440]	[0.440]	[0.440]	[0.442]	[0.442]	[0.442]	[0.489]	[0.489]	[0.489]
p (T2=T4)	0.002	0.001	0.005	0.067	0.0323	0.0447	0.893	0.899	0.73	0.245	0.233	0.212
q -value	[0.018]	[0.018]	[0.018]	[0.454]	[0.454]	[0.454]	[0.538]	[0.538]	[0.538]	[0.301]	[0.301]	[0.301]
Strata fixed efffects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline covariates	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Inverse probability weights (IPW)	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: This table presents the results of the treatments on the number of ANC visits, and IFA tablet consumption as reported by the daughter-in-law (DIL) at midline and endline. Each column represents a separate regression. The outcome variable of interest are number of ANC completed at the time of the survey and the number of iron and folic acid tablets consumed. The number of ANC visits are self-reported at midline and endline. The number of IFA tablets consumed at midline were only asked to participants who had registered their pregnancy, and had a Mother and Child Protection (MCP) card. Both outcomes were winsorized to the 95th percentile for outliers. Panel A shows the effect of the pooled treatments on the outcomes, where the treatment variable is 1 if the DIL or MIL belong to the group or individual treatment and 0 if they belong to the control group. Panel B presents results for the same outcome for all four treatments, where the treatment variable is 1 if the DIL or MIL belong to T1-T4 and 0 if they belong to the control group. We present three models for both participants: (1), (2), and (3). All models include strata fixed effects, and robust standard errors clustered at the village level are shown in parentheses. Model (2) also includes baseline covariates selected using post-double selection (Chernozhukov et al. (2018)), and model (3) includes inverse probability weights to account for differential attrition. We present sharpened False Discovery Rate (FDR) adjusted q-values (DIL and MIL outcomes, and midline and endline outcomes were grouped separately) to correct for multiple hypothesis testing (Anderson (2008)). *** p <0.01, ** p <0.05, * p <0.1

Table 3.4: Flyer signed and district hospital visited

	Daughter-in-law reported			
	Flyer signed		District hospital visited	
	(1)	(2)	(1)	(2)
Panel A. Pooled treatments				
Group	-0.023	-0.025	0.050	0.039
	(0.015)	(0.017)	(0.038)	(0.041)
	0.116	0.156	0.188	0.342
Mean of reference group (Individual)	0.972	0.972	0.610	0.610
Observations	1,400	1,287	1,400	1,287
Panel B. All treatments				
T2: Individual + DIL&MIL	-0.002	-0.002	0.054**	0.068**
	(0.010)	(0.010)	(0.027)	(0.027)
	0.848	0.865	0.049	0.013
T3: Group + Only DIL	-0.022	-0.021	0.056	0.052
	(0.015)	(0.014)	(0.043)	(0.043)
	0.155	0.141	0.198	0.230
T4: Group + DIL&MIL	-0.026*	-0.026*	0.097**	0.097**
	(0.015)	(0.014)	(0.044)	(0.045)
	0.080	0.066	0.030	0.031
Mean of reference group (T1: Individual + Only DIL)	0.971	0.971	0.579	0.579
Observations	1,400	1,287	1,400	1,287
p(T3=T4)	0.763	0.689	0.288	0.464
p(T2=T4)	0.172	0.152	0.081	0.058
Strata fixed efffects	Yes	Yes	Yes	Yes
Baseline covariates	No	Yes	No	Yes

Notes: This table presents the results of the treatments on flyer signed and district hospital visited as reported by the DIL at endline. We do not include the control group in this analysis, as control did not get the flyer. Each column represents a separate regression. The outcome variable of interest are indicators which are 1 if the daughter-in-law reported signing the flyer or visiting the district hospital and, and 0 if they did not. Panel A shows the effect of the pooled treatments on the outcomes, where the treatment variable is 1 if the DIL belongs to the group treatment and 0 if they belong to the individual treatment. Panel B presents results for the same outcome for cross-randomized treatments, where the treatment variable is 1 if the DIL or MIL belong to T2-T4 and 0 if they belong to T1. We present two models for participants: (1), and (2). All models include strata fixed effects, and robust standard errors clustered at the village level are shown in parentheses. Model (2) also includes baseline covariates selected using post-double selection (Chernozhukov et al. (2018)). We excluded 7 villages from the sample as they did not receive the treatments, and 14 control villages as they were given the treatment. *** p <0.01, ** p <0.05, * p <0.1

Table 3.5: Maternal and infant complications

	Daughter-in-law reported (endline)											
	Complications during pregnancy			Complications during birth			Post-delivery complications			Infant-related complications		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Panel A. Pooled treatments												
Group	0.032*	0.031*	0.026	-0.009	-0.009	-0.008	0.005	0.005	-0.002	-0.020	-0.016	-0.008
	(0.017)	(0.017)	(0.018)	(0.028)	(0.028)	(0.028)	(0.026)	(0.026)	(0.027)	(0.022)	(0.021)	(0.021)
	0.057	0.061	0.148	0.737	0.752	0.782	0.850	0.850	0.955	0.363	0.438	0.710
Individual	-0.006	-0.007	-0.006	-0.018	-0.016	-0.007	-0.067**	-0.067**	-0.071**	-0.057**	-0.055**	-0.040*
	(0.016)	(0.016)	(0.017)	(0.029)	(0.028)	(0.028)	(0.029)	(0.029)	(0.030)	(0.024)	(0.024)	(0.022)
	0.706	0.676	0.726	0.539	0.569	0.811	0.024	0.024	0.017	0.020	0.021	0.078
Control mean	0.056	0.056	0.056	0.131	0.131	0.131	0.108	0.108	0.108	0.081	0.081	0.081
Observations	1,844	1,844	1,702	1,844	1,844	1,702	1,799	1,799	1,658	1,799	1,796	1,658
p (Group=Individual)	0.012	0.011	0.039	0.721	0.749	0.963	0.000	0.000	0.001	0.012	0.010	0.034

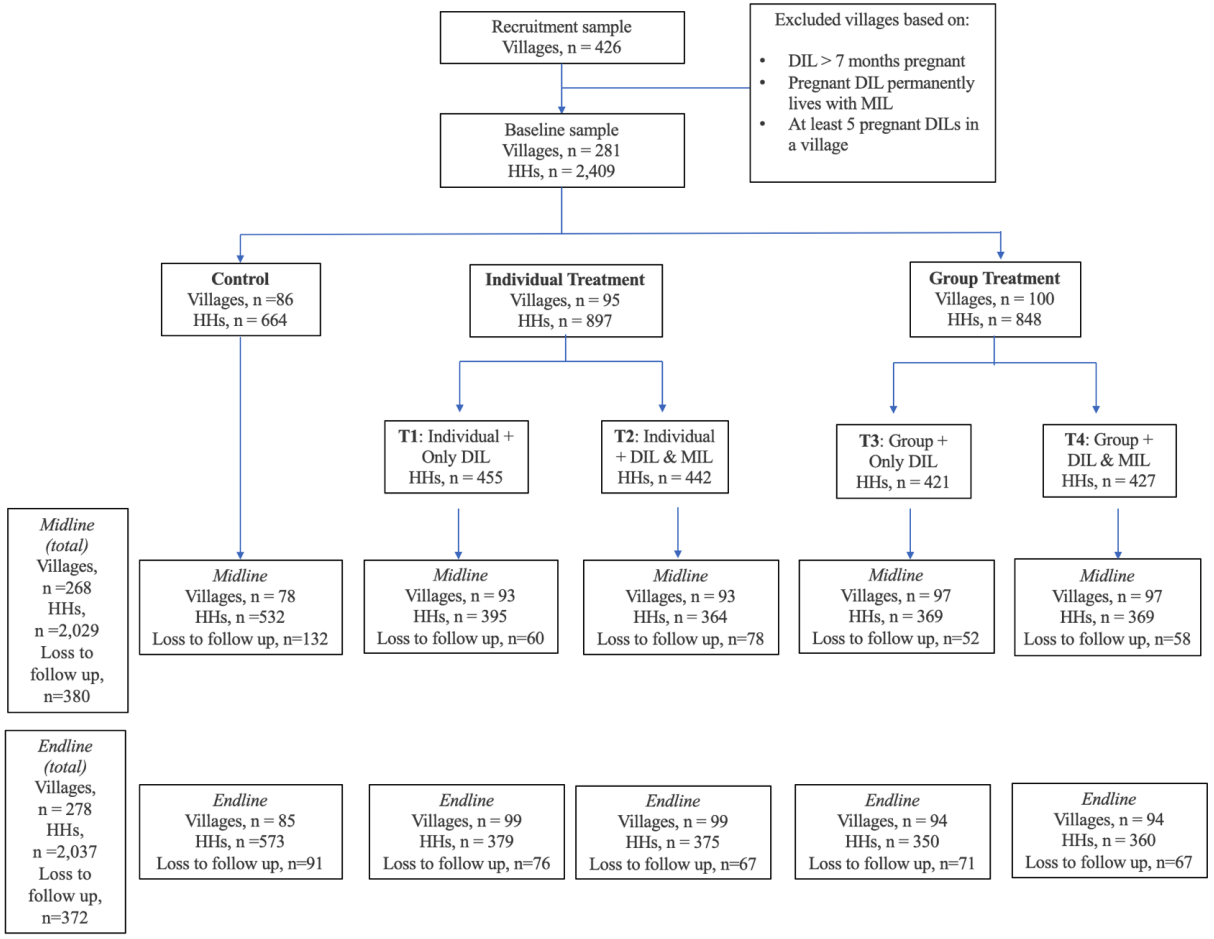
(continued on next page.)

Panel B. All treatments

T1: Individual + Only DIL	-0.016	-0.017	-0.019	-0.027	-0.026	-0.021	-0.073**	-0.073**	-0.079***	-0.053**	-0.051**	-0.033
	(0.018)	(0.018)	(0.018)	(0.031)	(0.031)	(0.030)	(0.030)	(0.030)	(0.030)	(0.026)	(0.025)	(0.024)
	0.353	0.338	0.302	0.391	0.410	0.486	0.016	0.016	0.009	0.040	0.044	0.180
T2: Individual + DIL&MIL	0.005	0.004	0.007	-0.008	-0.006	0.007	-0.060*	-0.060*	-0.063*	-0.060**	-0.058**	-0.046**
	(0.018)	(0.018)	(0.019)	(0.029)	(0.029)	(0.028)	(0.032)	(0.032)	(0.032)	(0.025)	(0.024)	(0.023)
	0.781	0.809	0.708	0.797	0.841	0.792	0.059	0.059	0.051	0.017	0.018	0.050
T3: Group + Only DIL	0.015	0.015	0.018	-0.018	-0.018	-0.006	-0.017	-0.017	-0.017	-0.034	-0.031	-0.023
	(0.019)	(0.019)	(0.020)	(0.032)	(0.032)	(0.033)	(0.030)	(0.030)	(0.032)	(0.023)	(0.022)	(0.022)
	0.353	0.338	0.302	0.581	0.580	0.852	0.578	0.578	0.588	0.130	0.156	0.295
T4: Group + DIL&MIL	0.048**	0.048**	0.035*	-0.001	0.000	-0.009	0.026	0.026	0.014	-0.006	-0.002	0.006
	(0.019)	(0.019)	(0.020)	(0.029)	(0.029)	(0.028)	(0.027)	(0.027)	(0.027)	(0.024)	(0.023)	(0.024)
	0.013	0.015	0.089	0.970	0.997	0.764	0.334	0.334	0.614	0.810	0.936	0.792
Control mean	0.056	0.056	0.056	0.131	0.131	0.131	0.108	0.108	0.108	0.081	0.081	0.081
Observations	1,844	1,844	1,702	1,844	1,844	1,702	1,799	1,799	1,658	1,799	1,796	1,658
p(T1=T2)	0.078	0.081	0.374	0.493	0.465	0.925	0.059	0.059	0.174	0.088	0.082	0.102
p(T3=T4)	0.170	0.171	0.100	0.355	0.347	0.148	0.511	0.511	0.419	0.642	0.630	0.401
p(T1=T3)	0.089	0.087	0.058	0.759	0.793	0.625	0.010	0.010	0.005	0.293	0.275	0.601
p(T2=T4)	0.031	0.029	0.167	0.794	0.808	0.517	0.002	0.002	0.007	0.004	0.003	0.008
Strata fixed efffects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline covariates	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Inverse probability weights (IPW)	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: This table presents the results of the treatments on maternal and infant related complications as reported by the daughter-in-law (DIL) at the endline only. Each column represents a separate regression. The outcome variable of interests indicators which are 1 if the daughter-in-law reported that she or the infant experience complications during pregnancy, brith or after delivery, and 0 if they did not. Panel A shows the effect of the pooled treatments on the outcomes, where the treatment variable is 1 if the DIL or MIL belong to the group or individual treatment and 0 if they belong to the control group. Panel B presents results for the same outcome for all four treatments, where the treatment variable is 1 if the DIL or MIL belong to T1-T4 and 0 if they belong to the control group. We present three models for both participants: (1), (2), and (3). All models include strata fixed effects, and robust standard errors clustered at the village level are shown in parentheses. Model (2) also includes baseline covariates selected using post-double selection (Chernozhukov et al. (2018)), and model (3) includes inverse probability weights to account for differential attrition. We excluded 7 villages from the sample as they did not receive the treatments, and 14 control villages as they were given the treatment. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Figure 3.1: Study flow diagram



Notes:At midline, we dropped 7 villages from the study as they were contaminated, and at endline we dropped an addditional 14 control villages that accidently received the treatment. Villages were first randomized into Group or Individual treatments, and then households in each village were randomized into Only DIL or DIL & MIL treatments. Since one village can have multiple household level treatments, we only show unique number of villages here for T1-T4 and the midline and endlin totals. The loss to follow up for midline and endline are compared to control as we tried each village and household at endline even if we didn't get them at midline.

Chapter 4

Impact of a mobile messaging service for families on postnatal care knowledge and practices: Evidence from a cluster randomized trial in India

ABSTRACT

Objectives To evaluate the impact of a mobile messaging service that delivers messages on postnatal care practices following WHO guidelines via the WhatsApp platform for families from birth through six weeks postpartum.

Methods We randomized tertiary hospitals in four states in India into a treatment group of 15 hospitals where the messaging service was promoted to families in maternity wards prior to discharge following a recent birth. Nine hospitals served as a control where families received in-hospital standard-of-care information. We recruited 21,937 mothers, primarily of lower socioeconomic status, over a 10-month period to participate in the study. Using logistic regression controlling for state-fixed effects and baseline covariates, we examine intent-to-treat (ITT) estimates and report risk differences.

Findings We observed significant positive impacts across the majority of neonatal and maternal care practices examined (p-values<0.05), with an estimated 3.1 percentage point (pp) increase in breastfeeding, 4.1 pp increase in recommended cord care practice, 9.2 pp increase in skin-to-skin care with mothers, and 2.2 pp increase in skin-to-skin care by fathers. We observed a significant and positive impact on some recommended maternal dietary practices, with 7.1 pp, 7.9 pp, and 10.8 pp increases in adherence to guidelines advising no reduction of food intake, no reduction of water intake, and no restrictions on food items, respectively (p-values<0.01).

Conclusion This study demonstrates that concise yet comprehensive digital messaging de-

livered to families during the postpartum period can effectively encourage recommended postnatal care practices. [1]

[1]This chapter presents results from an analysis conducted in collaboration with Jamie Johnston (Stanford), Shirley Yan (Noora Health), Adithi Chandrasekhar(Noora Health), Seemaa Murthy(Noora Health), Victoria Ward (Stanford), Saumya Singla(Stanford).

4.1 Introduction

Reducing maternal and neonatal mortality is a pressing global health priority, particularly in regions like India, where the burden is significant (noa (2024); Liu et al. (2019); UNICEF (2023)). For the last decade, national and state policy initiatives have focused on decreasing preventable maternal and infant deaths in India (Datta et al. (2022)). However, despite recent progress, the rate of maternal and neonatal deaths remains high, particularly among the country's poorest households (Liu et al. (2019); Meh et al. (2022); Tripathy and Mishra (2017)).

The Lancet's neonatal survival series underscores the importance of health education interventions that improve postnatal care practices to save lives and improve infant and mother well-being (Bhutta et al. (2014); Darmstadt et al. (2005, 2008); Knippenberg et al. (2005)). Providing predischarge information and postnatal health education to new parents in the critical time period following childbirth has significantly impacted the improvement of knowledge and care practices (Dol et al. (2019a)). Several health education interventions aim to address this need (Subramanian et al. (2020)), including the Care Companion Program (CCP), designed by the non-profit organization Noora Health in partnership with governments in India, Bangladesh, and Indonesia. This in-hospital education program aims to fill a gap in the provision of postnatal education in hospitals (Murthy et al. (2023)). Through interactive sessions run by health educators in postpartum maternity wards, mothers and their family caregivers are invited to attend in-hospital training sessions on essential care practices following World Health Organization (WHO) guidelines (WHO (2024)).

The CCP model is grounded in the strong body of evidence pointing to the importance of family members in postnatal care (Martin et al. (2020, 2021)). In India, family members, particularly grandmothers of new infants, not only support new mothers with caregiving but are also primary household decision-makers for maternal and infant care (Choudhry (1997); Withers et al. (2018)). Evidence suggests that new mothers are more likely to take up WHO-recommended best practices when they receive stronger family support (Allendorf (2010); Nguyen et al. (2019)). The model has shown promising results, with evidence suggesting improvements in health outcomes (Kashyap et al. (2022); Murthy et al. (2023); Subramanian et al. (2020)).

Despite the successes observed, anecdotal evidence suggests gaps in CCP, notably in follow-up care post-discharge. Many patients fail to return for postnatal doctor appointments, missing out on crucial information and support. Evidence from the parent-education literature points to the challenges observed, chief among them related to the time and resources required to provide effective postnatal health education (Gilmer et al. (2016)). Often, the families that fall through the gaps are the poorest and those in rural regions, with limited literacy and fewer opportunities to access health centers and critical health information (Balarajan et al. (2011); Subramanian (2008)).

Increased access to digital technology presents a promising opportunity to overcome these challenges. India has witnessed a significant increase in smartphone penetration, with social media and messaging platforms like WhatsApp widely used across all demographics, in-

cluding lower socioeconomic status (SES) populations (Balkrishan et al. (2016)). Evidence also suggests parents seek out infant care advice through mobile devices (Richardson et al. (2019)). Increasingly, studies are demonstrating the effectiveness of perinatal education delivered to new parents through mobile phones, showcasing the potential for digital messaging interventions to bridge gaps in in-person information delivery to promote attendance in antenatal and postnatal care visits (Bossman et al. (2022); Dol et al. (2019b); Feroz et al. (2017); Lund et al. (2014); Watterson et al. (2015)), skilled birth attendance (Bossman et al. (2022)), breastfeeding and safe infant feeding (Mohamad Pilus et al. (2022); Murthy et al. (2019)), and immunizations (Bossman et al. (2022); Chakraborty et al. (2021); Gibson et al. (2017); LeFevre et al. (2022); Lubis et al. (2022); Murthy et al. (2019); Watterson et al. (2015)). However, more causal studies are needed to establish key ways to improve effectiveness for mobile messaging interventions, particularly in low- and middle-income countries (LMICs) (Bossman et al. (2022); Feroz et al. (2017); Watterson et al. (2015)).

Recognizing the shift in opportunity accompanying the widespread adoption of smartphones in India, CCP includes a mobile extension of the program, the Mobile Care Companion Program (MCCP). MCCP aims to continue providing key health information directly to households through channels like WhatsApp in the critical months following the discharge of new mothers from the hospital. In this study, we evaluate the impact of WhatsApp MCCP on maternal and newborn care practices through a cluster randomized trial in four states in India. The study contributes to the mobile health messaging literature in several distinct ways. First, we provide strong causal evidence on the effectiveness of a replicable model of mobile messaging on behavior change and the uptake of key recommended care practices among a low SES population. Second, while a majority of postnatal education interventions focus on a narrow set of practices (e.g., breastfeeding or immunization alone) (Dol et al. (2019a)), MCCP aims to provide concise yet comprehensive messaging across a broad set of practices. Third, unlike many postnatal interventions, MCCP actively targets information at the household level, inviting all family members active in caregiving to engage in the service alongside new mothers. The intervention design embraces family members' role in postnatal care and decision-making. The design also accommodates the fact that access to mobile phones is often shared within families, with use often determined by male heads of households (Mohan et al. (2020); Scott et al. (2021)).

4.2 Methods

4.2.1 MCCP Intervention

The Mobile Care Companion Program (MCCP) is a digital extension of Noora Health's Care Companion Program (CCP), which provides in-person training sessions conducted by nurses and health educators for new mothers and their family members in hospital maternity wards. MCCP seeks to deliver continued care advice to families via a free mobile messaging service on WhatsApp. At the end of every CCP training session, mothers and family caregivers

(commonly the fathers and grandmothers of newborns) are encouraged to enroll and provide a phone number to sign up for the service.
MCCP delivers 25 messages, including 7 videos, over 50 days (Supplement C.1. The messages are consistent with CCP content and promote WHO-recommended postnatal practices including early and exclusive breastfeeding, hygienic cord care, skin-to-skin care, vaccination, maternal nutrition recommendations, and recognizing warning signs of critical illness for mother and baby (WHO (2024)). Messages were reviewed by a team of medical experts and State Departments of Health. The service is available in 7 languages: English, Hindi, Kannada, Marathi, Punjabi, Tamil, and Telugu. Like CCP, MCCP directs advice to entire families rather than exclusively to new mothers. Upon introduction to MCCP, family members are encouraged to engage with the service alongside new mothers.
In addition to receiving care advice through MCCP, recipients can also ask questions. A team of trained support staff monitors and responds to questions; however, they do not provide medical consultation or advice on medications, rather they direct recipients to health providers for such queries.

4.2.2 Study design

To evaluate the effectiveness of MCCP, we designed a cluster-randomized controlled trial, with hospitals as the unit of randomization. The trial is registered on Open Science Framework, and CONSORT checklist in Supplement C.2. We selected 26 tertiary hospitals in four states (Karnataka, Madhya Pradesh, Maharashtra, and Punjab) for inclusion in the study. To achieve a representative sample of hospitals, we first stratified districts in each state by India's Health Management Information (HMIS) Health Index quartiles, and randomly selected a set of high- and low-delivery load hospitals where CCP had been implemented for at least two years. Two hospitals were excluded from the study. The first was excluded prior to randomization because the facility was converted to focus on COVID-19 treatment and births were diverted to alternative facilities. The second was excluded after randomization because the state government requested the hospital assigned to the CCP standard of care control start receiving the MCCP intervention three months after the start of the study. The hospitals were stratified by state, and 15 were randomly assigned via a random number generator to the treatment group where the MCCP intervention would be promoted, with 9 hospitals serving as a control, receiving only the in-person CCP. Figure 4.1 displays the participant flow diagram. Over a 10-month period, data collection field teams recruited new mothers to participate in the study in the 24 hospitals. Participants were recruited in maternity wards prior to hospital discharge following birth. All birthing women present at the time of data collection were invited to participate. Inclusion criteria included completing a demographic survey at the time of recruitment in hospitals and household ownership of a smartphone. Families in which newborns or mothers died prior to discharge were excluded. In treatment hospitals, out of 14,018 mothers recruited, 11,611 (82.8%) consented and met inclusion criteria. In control hospitals, 10,326 (87.4%) out of 11,806 recruited consented and met inclusion criteria.

4.2.3 Measures

Data collection teams conducted face-to-face demographic surveys with all consenting mothers during recruitment. In instances when new mothers were unable to respond, family members designated by the mother responded on their behalf. We constructed an SES index using the same methodology followed by the Indian National Family Health Survey (NFHS-4), assigning pre-determined weights to each socioeconomic indicator. We then summed and standardized these weights around the control group's mean. Roughly six weeks (55 days on average) after participants consented, data collection teams attempted to contact all participants to administer a follow-up phone survey. Our primary outcomes include post-discharge behaviors in three categories: (1) newborn care practices: exclusive breastfeeding, any breastfeeding, recommended umbilical cord care, skin-to-skin care, and six-week immunizations; (2) maternal dietary practices including adherence to recommendations not to reduce or restrict food and water and consumption of iron and folic and calcium supplements; (3) newborn and maternal complications, including post-discharge hospital readmissions. We also collected data on knowledge of newborn care practices regarding infant feeding, skin-to-skin care, and cord care.
We controlled for baseline characteristics from the demographic survey and imputed missing values for covariates using the median of the non-missing values conditioned on the state. The final set of covariates included in the model was determined using post-double selection (Chernozhukov et al. (2018)), with a complete list of high-dimensional controls provided in Supplement Table C.3. The outcomes analyzed and covariates used are the same as what was pre-specified by us in OSF. We analyze all dependent variables, and include each in a separate model. We then correct for multiple hypothesis testing.

4.2.4 Statistical analysis

To estimate the impact of the MCCP intervention, we present intent-to-treat (ITT) estimates, which capture the effect of offering the WhatsApp program, regardless of take-up. Our main estimating equation for the ITT is a logistic regression.

$$\log(P_{ih}) = \alpha + \beta_1 T_h + \gamma X_{ih} + \theta_s + \epsilon_{ih}$$

where the dependent variable P_{ih} represents the probability of an outcome for a mother i recruited in hospital h. The treatment variable T_h is a binary variable, which is 0 if a hospital is assigned the CCP standard of care, and 1 if it is assigned the MCCP intervention. Our main estimate of interest is β_1 which provides the ITT estimate of the impact of MCPP as compared to CCP. The vector X_{ih} consists of mother- and hospital-level covariates, selected using post-double selection to improve precision (Chernozhukov et al. (2018)). We include state-fixed effects (θ_s) and ϵ_{ih} is the error term clustered at the hospital level. We use a logistic regression model to estimate the results as outcomes are binary and report risk differences (RD) using the Stata margins command. We correct for multiple hypothe-

sis testing and present sharpened False Discovery Rate (FDR) adjusted q-values(Anderson (2008)). Analyses were conducted in Stata 16.

4.3 Ethics Review

This study received approval from the ACE Ethics Committee
(DCGI Reg. No. ECR/141/Indt/KA/2013/RR-19) based in Bangalore, India, and the Institutional Review Boards (IRBs) at Stanford University, California (IRB-65931) and the University of California, Berkeley (2024-04-17420). All participants consented in their local language.

4.4 Results

4.4.1 Sample balance and attrition

The in-hospital demographic survey had a high consent and completion rate of over 98% in both control and treatment groups, as shown in Figure 4.1. Following the survey, we applied the inclusion criteria and excluded families without access to a smartphone. Supplement Table C.4 presents the demographic characteristics of the excluded sample and shows a lower SES compared to the included sample. The study's overall loss-to-follow-up rate was 35.6% (Figure 4.1). We observe no significant differences in attrition between the control and treatment groups (Supplement Table C.5). Attriters were more likely to have someone other than the mother complete the demographic survey, experience newborn readmission to the hospital after delivery, belong to other minority social categories, and possess fewer household assets (Supplement Table C.6). Table 4.1 shows differences in pre-intervention characteristics in our analytic sample (mothers responding to the follow-up survey). Treatment and control appear well-balanced on observed characteristics. Supplement Table C.7 shows similar patterns of balance across the two groups for the full sample of mothers randomized at baseline. Significant, but small differences exist between the groups in the proportion of first-time mothers and number of previous births. The average age of the mothers at baseline across the two groups was approximately 24 years. Vaginal delivery accounted for just over half of the births, and mothers had an average of 1.2 previous births. The majority of mothers, about 80%, are from the Scheduled Caste/Tribe (SC/ST) social category indicating lower socio-economic status, and the majority of mothers possess a Below Poverty Line (BPL) card. Most mothers are homemakers and completed secondary education.

4.4.2 MCCP participation

Table 4.2 presents mother-reported engagement with MCCP. At follow-up, 61.75% of mothers in the treatment group recalled which family member enrolled in MCCP, with 70.15%

reporting themselves as enrollees, 22.18% reporting spouses, and 7.67% reporting other relatives. Under half (44.07%) recalled viewing MCCP messages, and of these mothers, nearly all (96.48%) reported understanding messages, while 37.51% recalled viewing any videos, and 15.82% recalled asking questions on the platform. Of mothers who recalled viewing videos, 28.06% shared information or videos with other family members. Of mothers whose family members enrolled (either spouse or other family member), 67.25% recalled family members sharing information or videos with them.

4.4.3 Effect on postnatal care practices

Table 4.3 presents the results of our main specification (4.2.4). We divide our results into three categories: (1) newborn care practices, (2) maternal diet, and (3) newborn and maternal complications. The MCCP intervention improved four of the six newborn care practices measured (p-values < 0.05). Mothers in the treatment group experienced increases of 3.1 percentage points (pp) in any breastfeeding, 4.1 pp in practicing recommended cord care, 9.2 pp in skin-to-skin care by the mother, and 2.2 pp in skin-to-skin care by the father. We observed no significant impact on exclusive breastfeeding or six-week vaccinations. We observed significant improvements in three of the five maternal diet practices measured (p-values < 0.01). Mothers in the treatment group were significantly more likely to adhere to recommendations advising that they do not reduce their food intake (7.1 pp increase) or water intake (7.9 pp increase) or restrict specific food items (10.8 pp increase). We do not observe any significant impact on supplement consumption. We observe no differences in newborn complications at follow up. Mothers in the treatment group were significantly more likely to report experiencing complications after discharge (RD: 2.1 pp, p-value<0.01).

4.4.4 Effect on postnatal care knowledge

Table 4.4 presents the results of our main specification (4.2.4) on knowledge. We observed a significant impact on two of the five knowledge outcomes measured (p-values < 0.01). Mothers in the treatment group were significantly more likely to know to breastfeed even when the mother has a fever (8.7 pp) and to know about skin-to-skin care (14.9 pp). Calculation of q-values combined all outcomes reported in Tables 3 and 4, and conclusions regarding the significance of outcomes were consistent with p-values. Supplement Tables C.8 and C.9 show the unadjusted results of the primary outcomes on treatment, which are robust to adjusted specifications.

4.5 Discussion

This study demonstrates that delivery of simple concise, yet comprehensive messaging to families in the postpartum period can positively influence the uptake of WHO-recommended postnatal care practices. While MCCP covered the same content as CCP education also re-

ceived in control hospitals, delivery of the messages spaced over the 6-week period resulted in improvements in a majority of neonatal practices measured. These findings suggest there is added value to mobile delivery of information with optimal timing to correspond to newborn milestones, viewed at the recipient's discretion, and stored on devices allowing for access as a reference tool when needed.

Delivery of messages to mobile devices also allows for the sharing of information among family members providing postnatal care. A defining feature of MCCP is messaging directed to the entire household. While our study is limited by reliance on maternal self-report given an inability to link WhatsApp platform analytics with participants, we nonetheless observed evidence of engagement in MCCP among family members, with nearly a third initiating household enrollment, for which nearly two-thirds of mothers reported receiving information from family members. Likewise, nearly a third of mothers who recalled using MCCP reported sharing with family members. Future studies should explore the shared nature of phone ownership and ways in which messaging services can individualize and direct educational content to family caregivers to increase effectiveness.

Our study demonstrates the impact of a mobile intervention among a largely low socioeconomic population (roughly 80% SC/ST and 60% BPL), with several implications worth noting. The proliferation of smartphones in India, even among those of low SES, highlights the potential of digital interventions to overcome barriers faced by poorer, marginalized populations with limited access to facilities and quality in-person care. In our study, smartphone ownership was high among all families delivering in hospitals, with only 13.65% excluded due to lack of a smartphone. Although this criterion excludes the poorest in communities, our study nonetheless demonstrates impact among a largely low SES population. However, we assert there are still equity implications for the delivery of information that require additional resources. The lack of impact on supplement consumption and vaccination (requiring travel to vaccination sites) suggests that educational interventions alone do not solve for the resources needed to engage in certain practices. Finally, while MCCP was designed as a two-way service, it was largely used as a one-way source of information, with only 15.82% of mothers who recalled receiving messages reported asking questions. While the interactive component is costlier to maintain, our study may suggest that even simple information delivery can positively impact care, consistent with evidence that one-way postnatal messaging can be cost-effective at saving lives (LeFevre et al. (2023)). Our data do not allow us to speak to the importance of the interactive aspects of MCCP for the small number of mothers utilizing it. We recommend future studies explore how interactive messaging services can identify at-risk patients and provide information individualized to their needs.

Table 4.1: Baseline balance of analytic sample

	Control (n = 6,650)		**Treatment (n = 6,841)**		**Treatment vs. Control**	
	mean	sd	mean	sd	*p*-values	
Mother's age	24.27	3.769	24.39	3.660	0.604	
Newborn is male	0.523	0.500	0.524	0.499	0.625	
Primary respondent is the mother	0.986	0.116	0.972	0.164	0.413	
Vaginal delivery	0.566	0.496	0.502	0.500	0.788	
First time mothers	0.218	0.413	0.265	0.442	0.010	**
Number of previous live births	1.292	0.989	1.164	0.952	0.015	**
Category: General	0.141	0.348	0.119	0.324	0.424	
Category: Scheduled caste/scheduled tribe	0.822	0.382	0.828	0.377	0.606	
Category: Other	0.037	0.189	0.052	0.223	0.825	
Ownership of a Below Poverty Line (BPL) card	0.573	0.495	0.608	0.488	0.440	
SES index	0.000	1.000	-0.008	1.006	0.872	
Ownership of household items:						
Pressure cooker	0.782	0.413	0.779	0.415	0.872	
Color television	0.748	0.434	0.721	0.448	0.601	
Refrigerator	0.394	0.489	0.390	0.488	0.205	
Table	0.241	0.428	0.402	0.490	0.110	
Washing machine	0.094	0.291	0.169	0.375	0.215	
Sewing machine	0.238	0.426	0.206	0.405	0.781	
Air conditioner/cooler	0.337	0.473	0.266	0.442	0.826	
Mattress	0.568	0.495	0.630	0.483	0.958	
Motorcycle/scooter	0.602	0.490	0.594	0.491	0.159	
None of these	0.051	0.219	0.063	0.243	0.872	
Home roof material is concrete	0.624	0.484	0.664	0.472	0.477	
Household uses LPG fuel mostly for cooking	0.826	0.379	0.885	0.319	0.219	
Household uses open toilet	0.271	0.444	0.130	0.336	0.051	*
Highest level of education						
No formal schooling	0.124	0.330	0.053	0.225	0.167	
Primary school completed	0.061	0.240	0.043	0.202	0.222	
Secondary school completed	0.465	0.499	0.484	0.500	0.327	
Higher than secondary school completed	0.349	0.477	0.419	0.493	0.266	
Occupation						
Unemployed	0.004	0.064	0.029	0.169	0.292	
Homemaker	0.807	0.395	0.870	0.336	0.331	
Self-employed	0.036	0.187	0.037	0.190	0.852	
Daily wage worker	0.130	0.336	0.036	0.186	0.137	
Private sector employee	0.015	0.122	0.022	0.148	0.463	
Public sector employee	0.008	0.089	0.005	0.068	0.127	

Notes: This table shows the means and standard deviations of the participants in the control and treatment groups after the intervention is completed, and at the time of the followup survey. This table represents the final analytic sample after loss-to-follow-up. For binary characteristics, the proportion of participants is shown. The p-values here represent significant differences between control and treatment along these characteristics. The p-value displayed is from a regression of the dependent variable on an indicator variable for treatment. State fixed effects are included, and standard errors were clustered at the hospital level (not shown here). The SES index is calculated using the methodology from the NFHS-4 and standardized around the control group. * denotes statistical significance at 10 pct, ** at 5 pct, and *** at 1 pct level.

Table 4.2: Mother-reported MCCP takeup and engagement

	n	%	N
Mother recalled which family member enrolled in MCCP	4224	61.75	6841
Mother (self)	2963	70.15	4224
Spouse	937	22.18	4224
Other family member	324	7.67	4224
Mother cannot recall who or if anyone enrolled in MCCP	2617	61.39	6841
Engagement with MCCP			
Mother recalled viewing messages on WhatsApp	3015	44.07	6841
Mother understood messages received	2909	96.48	3015
Mother viewed any linked videos	1131	37.51	3015
Mother asked questions on the platform	477	15.82	3015
Mother shared information or videos with family members	846	28.06	3015
Family members shared information or videos with the mother	848	67.25	1261

Notes: This table presents data on engagement with the MCCP intervention and data are displayed as n and %. Household member who enrolled shows which household member called to enroll in the WhatsApp service. Whether a family member shared the message with the mother was only asked of mothers who recalled family members enrolling in MCCP.

Table 4.3: Effect of MCCP on newborn care, maternal diet, and complications (N=13,491)

Outcomes	Control mean	RD	95% CI	*p*-value	*q*-value
Newborn care practices					
Exclusive breastfeeding	0.499	0.018	[-0.060, 0.096]	0.654	0.563
Fed any breastmilk	0.941	0.031	[0.015, 0.047]	0.000 ***	0.001
Practiced recommended cord care	0.489	0.041	[0.004, 0.078]	0.029 **	0.056
Mother practiced skin-to-skin with newborn	0.094	0.092	[0.062, 0.122]	0.000 ***	0.001
Father practiced skin-to-skin with newborn	0.010	0.022	[0.007, 0.038]	0.005 **	0.012
Completed six-week vaccinations	0.509	0.042	[-0.015, 0.099]	0.146	0.259
Maternal dietary practices					
No reduction of food intake	0.697	0.071	[0.050, 0.092]	0.000 ***	0.001
No reduction of water intake	0.751	0.079	[0.036, 0.121]	0.000 ***	0.001
No restriction of food items	0.380	0.108	[0.071, 0.145]	0.000 ***	0.001
Consumed iron and folic acid supplements	0.124	0.060	[-0.032, 0.153]	0.198	0.267
Consumed calcium supplements	0.116	0.065	[-0.016, 0.146]	0.114	0.214
Newborn and maternal complications					
Newborn admitted to hospital after discharge	0.068	0.003	[-0.017, 0.023]	0.784	0.697
Newborn experienced complications after discharge	0.295	0.022	[-0.008, 0.051]	0.157	0.259
Mother admitted to hospital after discharge	0.012	0.002	[-0.004, 0.008]	0.482	0.504
Mother experienced complications after discharge	0.112	0.021	[0.007, 0.035]	0.004 **	0.010
Experienced issues with cord care	0.056	-0.003	[-0.015, 0.009]	0.624	0.563

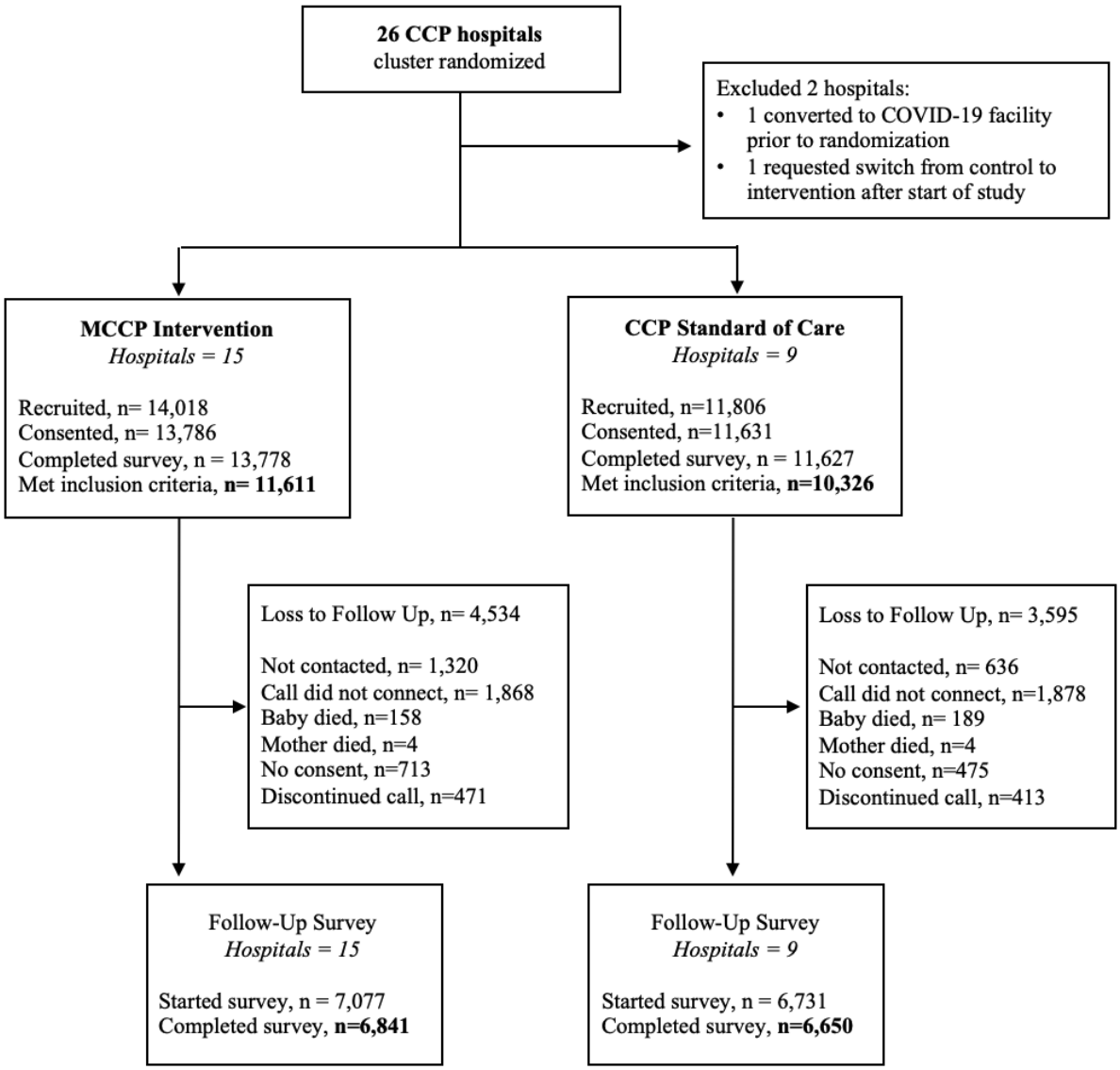
Notes: This table presents the results of a logistic regression of the primary outcomes on treatment. Each row represents a separate regression. All outcome variables presented are indicators that are 0 if the behavior was not practiced, and 1 if the behavior was practiced. The treatment variable is an indicator that is 0 if they were assigned to the control group and 1 if they were assigned to treatment. Covariates were included in all regressions using post-double selection (Chernozhukov et al. (2018)), and missing values were imputed using the median of the non-missing values conditional on the state. Standard errors (not shown here) are robust, and are clustered at the hospital level. We present sharpened False Discovery Rate (FDR) adjusted q-values (that include all outcomes from Tables 4.3 and 4.4) to correct for multiple hypothesis testing (Anderson (2008)). * denotes statistical significance for p-values at 10 pct, ** at 5 pct, and *** at 1 pct level. RD: risk difference; CI: confidence interval.

Table 4.4: Effect of MCCP on newborn care knowledge

Knowledge outcomes	**Control mean**	**RD**	**95% CI**	***p*-value**	***q*-value**
Know to breastfeed when mother has a fever	0.402	0.087	[0.041, 0.133]	0.000 ***	0.001
Know to breastfeed jaundiced newborn	0.535	0.049	[-0.024, 0.121]	0.189	0.267
Know age to start complementary feeding	0.683	-0.045	[-0.109, 0.019]	0.172	0.265
Know recommended cord care	0.38	0.021	[-0.036, 0.079]	0.467	0.504
Know about skin-to-skin care	0.185	0.149	[0.105, 0.194]	0.000 ***	0.001

Notes: This table presents the results of a logistic regression of the knowledge outcomes on treatment. Each row represents a separate regression. All outcome variables presented are indicators that are 0 if they did not have the correct response to the knowledge question, and 1 if they did. The treatment variable is an indicator that is 0 if they were assigned to the control group and 1 if they were assigned to treatment. Covariates were included in all regressions using post-double selection (Chernozhukov et al. (2018)), and missing values were imputed using the median of the non-missing values conditional on the state. Standard errors (not shown here) are robust, and are clustered at the hospital level. We present sharpened False Discovery Rate (FDR) adjusted q-values (that include all outcomes from Tables 3 and 4) to correct for multiple hypothesis testing (Anderson (2008)). * denotes statistical significance of p-values at 10 pct, ** at 5 pct, and *** at 1 pct level. RD: risk difference; CI: confidence interval.

Figure 4.1: Participant flow diagram



Notes: Notes: Two hospitals were excluded from the study. The first was excluded prior to randomization because the facility was converted to focus on COVID-19 treatment and births were diverted to alternative facilities. The second was excluded because the state government requested the hospital assigned to the CCP standard of care control start receiving the MCCP intervention three months after the start of the study. Participant inclusion criteria includes completion of baseline survey at the time of recruitment in hospitals and household ownership of a smartphone through which WhatsApp can be accessed. Households with mothers or babies who died prior to hospital discharge were also excluded.

Chapter 5

Discussion

This dissertation contributes new evidence on the mechanisms influencing health decision-making within multi-generational households in LMICs, focusing on the critical perinatal period. Adequate preventative care, including routine checkups and early screenings, significantly impacts the health of both the mother and the fetus. The postpartum period is crucial for the mother's physical and mental recovery. The first two years after birth is vital for the infant's development, potentially having lifelong consequences (UNICEF (2023)). Problems during pregnancy, birth, and postpartum are among the leading causes of death for young, otherwise healthy women aged 20 to 45 globally (WHO (2024)).

Addressing maternal and infant mortality is a global priority, with substantial governmental resources dedicated to this issue. Despite progress in recent decades, many countries continue to experience significantly higher than the global average maternal and infant mortality rates, particularly among marginalized communities and for women with limited autonomy (Aziz et al. (2021); Fotso et al. (2009); Mondal et al. (2020)). Much existing research has focused on supply-side factors like improving accessibility, quality of care, and pay-for-performance; demand-side interventions (such as conditional cash transfers, voucher programs, and community mobilization) have been of interest as well but have shown mixed evidence (Bowser et al. (2016)).

A growing body of work in economics points to several mechanisms where household structure might influence health and labor decisions, as well as the autonomy of younger women residing in those households. Family members like the mother-in-law play an outsized role in determining household decisions around fertility, demand for health services, labor force participation, and allocation of household resources (Allendorf (2010); Anukriti et al. (2019, 2022); Banerji et al. (2023); Gram et al. (2018); Khanna and Pandey (2020)).

In this dissertation, I presented three studies in India to understand the role of household members in perinatal decision-making. I provided causal evidence on how the involvement of the mother-in-law impacts health-seeking behaviors and health outcomes. The first paper examined the dynamics between new mothers and their caregivers (spouse, mother, and mother-in-law) in caregiving decisions for postnatal maternal and infant care. I found that women were more likely to name their caregivers as sole decision-makers for both infant and

maternal care over themselves, and agreement between the mother and caregiver on who is the decision-maker is low. I also found the identity of the primary caregiver significantly affects maternal mental well-being. The second paper investigated the impact of targeted health messaging and social learning on antenatal care visits and iron and folic acid tablet consumption among pregnant women co-residing with their mothers-in-law. It demonstrated that involving mothers-in-law in health messaging increases health-seeking behaviors and improves post-delivery outcomes. The results also showed that the adoption of behaviors varies in the short and long term, with the effect on individual beliefs being stronger than the peer effects in the short term and then peer effects catching up in the long term. The third paper evaluated the effectiveness of a mobile messaging service delivering postnatal care information to households and its impact on maternal and infant health outcomes and found that a mobile messaging service delivering postnatal care information to the entire household positively affects maternal and infant health outcomes.

5.1 Policy implications

By quantifying the impact of family members, particularly the mother-in-law, on health-seeking behaviors and postnatal recovery in India, I highlight the importance of policy interventions that leverage household support to improve maternal and infant health outcomes. The findings of this dissertation suggest that policymakers have overlooked the critical role of household members, particularly the mother-in-law, in influencing health decisions and outcomes.

In Chapter 2, I find that family caregivers play a significant role in postpartum decision-making, often acting as the sole decision-maker for infant and maternal care. Notably, decisions are frequently made by a single household member, who is often not the new mother. For example, most interventions have a direct-to-beneficiary design and don't consider the family (LeFevre et al. (2022)). I suggest that policymakers adopt a family-centered approach to healthcare, recognizing the significant influence of household members on health-seeking behaviors and outcomes. This approach contrasts with the prevalent direct-to-beneficiary design of most interventions, which neglects the critical role of family members in healthcare decision-making.

In Chapter 3, I provide novel evidence on how intergenerational dynamics and social norms affect health-seeking behaviors during pregnancy, specifically regarding crucial preventative care such as ANC visits and IFA tablet consumption. My research reveals that engaging the mother-in-law has a significant and lasting impact on ANC and IFA tablet consumption, leading to improved post-delivery health outcomes for the mother and the infant. These findings challenge the conventional approach of targeting health information in LMICs solely to young married women, pregnant women, or new mothers (LeFevre et al. (2022)). Instead, I demonstrate that it is equally, if not more, effective to involve other household members, particularly the mother-in-law, in health interventions. Moreover, delivering health information in group settings or a public setting, focusing on addressing social norms,

can in some cases yield even more significant improvements in health-seeking behaviors and outcomes in the long term. However, future work will be required to better understand when group delivery will increase effectiveness, as in some settings strong pre-existing social norms could cause group delivery models to perform worse.

The findings in Chapter 4 demonstrate that mobile delivery of information offers added value beyond in-person interventions, as recipients can access messages at their discretion and store them for future reference. Moreover, mobile delivery enables information sharing among family members providing postnatal care, increasing the number of informed individuals in the household. This insight is crucial for policymakers. Leveraging mobile platforms like WhatsApp for information dissemination is a low-cost and easily implementable solution, especially since smartphone access is increasingly widespread in LMICs. Increasingly, studies have demonstrated the effectiveness of perinatal education delivered to new parents via mobile phones. These digital messaging interventions have shown potential in bridging gaps in in-person information delivery, promoting attendance at antenatal and postnatal care visits (Bossman et al. (2022); Dol et al. (2019b); Feroz et al. (2017); Lund et al. (2014); Watterson et al. (2015)), skilled birth attendance (Bossman et al. (2022)), breastfeeding and safe infant feeding practices (Mohamad Pilus et al. (2022); Murthy et al. (2019)), and immunizations (Bossman et al. (2022); Chakraborty et al. (2021); Gibson et al. (2017); LeFevre et al. (2022); Lubis et al. (2022); Murthy et al. (2019); Watterson et al. (2015)). However, more causal studies are needed to identify key strategies for improving the effectiveness of mobile messaging interventions, especially in low- and middle-income countries (LMICs)(Bossman et al. (2022); Feroz et al. (2017); Watterson et al. (2015)). Implementing partners should investigate the shared nature of phone ownership and explore strategies for individualizing and directing educational content to family caregivers to enhance effectiveness. This intervention also highlights a critical gap: individuals from very low socioeconomic backgrounds may be excluded due to limited device ownership. Further research is needed to address this disparity and ensure inclusive access to vital information to refine policy recommendations.

5.2 Future directions for research

5.2.1 Spousal involvement

This research establishes that household members, especially mother-in-law involvement, are crucial for health decision-making and affecting outcomes. However, this dissertation does not explore the role of the spouse. Future research should investigate the complex dynamics of household decision-making involving the spouse. Despite evidence showing the importance of father involvement in the perinatal period and early childhood (as seen in systematic reviews highlighting increased utilization of skilled birth attendants, institutional deliveries, postpartum visits, and reduced odds of postpartum depression) (Suandi et al. (2020); Yargawa and Leonardi-Bee (2015), our findings suggest that female caregivers, especially mothers-in-law, may limit spouses' involvement in infant care decisions.

Recent work by Ashraf et al. (2020) demonstrates the significant impact of providing information to men in the household on maternal mortality risk and fertility choices, while Ghosh and Thornton (2024) reveals the crowding out effect of couples counseling in households with dominant mothers-in-law. Building on these findings, future studies should explore intervention designs that can leverage the presence of mothers-in-law when trying to increase spouse involvement. It will be crucial to then investigate subsequent effects on maternal mental well-being, infant and child development, and overall health outcomes.

5.2.2 Extending bargaining models

This dissertation provides causal evidence on the significant influence of mothers-in-law on household decision-making, particularly in health-related choices. While studies from other disciplines have long recognized the crucial role of the mother-in-law-daughter-in-law relationship in household dynamics, including instances of collusion between the daughter-in-law and her spouse against the mother-in-law (Gram et al. (2018); Kandiyoti (1988)), traditional economic models of intra-household decision-making have overlooked the influence of extended family members, focusing instead on spousal bargaining.

To address this gap, the next step is to develop a theoretical framework of the household that accounts for multiple agents with misaligned incentives, and allowing for collusion. This framework will enable a more generalizable framework to design effective interventions to improve health outcomes. By acknowledging the significant influence of extended family members, we can move beyond the traditional spousal bargaining model and develop a more nuanced understanding of household decision-making.

5.2.3 Concluding Remarks

In conclusion, this dissertation provides significant insights into the complex dynamics of health decision-making within multi-generational households in LMICs, with a particular focus on the critical perinatal period. The findings underscore the profound influence that household members, especially mothers-in-law, have on health-seeking behaviors and outcomes. Through three empirical studies conducted in India, this research highlights the importance of involving family members in healthcare interventions to enhance maternal and infant health outcomes. The results challenge traditional approaches that primarily target individual beneficiaries, advocating instead for a family-centered approach that acknowledges the roles of various household members. Furthermore, the dissertation opens new avenues for future research, including the need to explore the role of spouses and to extend economic models of household decision-making to include multiple agents with potentially conflicting interests. This work not only contributes to the academic literature but also offers practical implications for policymakers seeking to design more effective health interventions in similar cultural contexts.

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Appendix A

Chapter 2 – Supplementary Tables and Figures

Table A.1: Birthing woman descriptive characteristics (no consenting caregiver)

	N	n (%)
Age	219	24.66 ± 0.22
Live in a rural village	219	154 (70.32)
State		
Madhya Pradesh	219	95 (43.38)
Karnataka	219	37 (16.90)
Punjab	219	75 (34.24)
Maharashtra	219	12 (5.48)
Caste		
General	219	71 (32.43)
Scheduled caste (SC)	219	62 (28.11)
Scheduled tribe (ST)	219	23 (10.27)
Not specified	219	34 (15.52)
Primary spoken language		
Hindi	209	107 (51.12)
Kannada	209	28 (13.40)
Punjabi	209	63 (30.14)
Marathi	209	7 (3.35)
Socio-economic status		
Ownership of HH goods - out of 7	219	4.74 ± 0.09
Ownership of Below Poverty Line (BPL) Card	219	121 (55.25)
Household characteristics		
Household size	219	4.48 ± 0.11
Number of years married	219	4.62 ± 0.23
Number of previous children	219	1.25 ± 0.05
Birth-related characteristics		
First-time mothers	219	119 (54.33)
Postpartum residence in maternal home	219	122 (55.70)

Notes: This table presents the descriptive characteristics of birthing women in the analysis sample, whose caregivers did not consent to the survey. Data are displayed as either mean±SD or n(%). Socio-economic status is presented as a score by counting the ownership of seven common household goods. Ownership of the Below Poverty Line (BPL) card is an indicator for whether the respondent's family has a government issued card. Postpartum residence in maternal home is an indicator for whether the respondent (birthing woman) lived in their mother's home immediately following birth.

Table A.2: Types of caregivers, by relationship to birthing women (N=551)

	n	%
Spouse	170	30.91
Mother	142	25.82
Mother-in-law	96	17.45
Other	36	6.55
Daughter	31	5.64
Sister	26	4.73
Sister-in-law	18	3.27
Father	12	2.18
Brother	5	0.91
Father-in-law	3	0.55
Maternal aunt	3	0.55
Niece	2	0.36
Grandmother	2	0.36
Children of other family members	2	0.36
Son	1	0.18
Cousin	1	0.18

Notes:This table presents the n and % for the caregiver relationships as reported by the birthing woman and in relation to her

Table A.3: Mental well being index components (N = 551)

	Spouse (N = 170)		Mother (N = 142)		Mother in law (N = 96)	
	n	%	n	%	n	%
I am afraid to go to the doctor/hospital to seek treatment	69	40.59	52	36.62	34	35.42
The ASHA/ANM is too busy with her work and are unable to respond to my concerns	78	45.88	88	61.97	40	41.67
I don't have any family or friends to turn to as nobody is allowed to step outside	61	35.88	92	64.79	41	42.71
I am spending a lot more time taking care of children	138	81.18	126	88.73	74	77.08
I do not feeling like eating; my appetite was poor	33	19.41	16	16.90	16	16.67
My husband and I are fighting more	12	7.06	6	4.23	6	6.25
I am worried about my health	55	32.35	42	29.58	30	31.25
I am worried about the health of my baby	66	38.82	48	33.80	34	35.42
I am bothered by things that didn't usually bother me	51	30.00	25	17.61	13	13.54
The environment in my home is tense	29	17.16	36	25.35	12	12.50

Notes:This table presents the n and % for the respondents answering yes to the components of the mental well-being index

Table A.4: Mental well being index components by dyad

	Spouse (N = 170)		Mother (N = 142)		Mother in law (N = 96)	
	n	%	n	%	n	%
I am afraid to go to the docotr/hospital to seek treatment	69	40.59	52	36.62	34	35.42
The ASHA/ANM is too busy with her work and are unable to respond to my concerns	78	45.88	88	61.97	40	41.67
I don't have any family or friends to turn to as nobody is allowed to step outside	61	35.88	92	64.79	41	42.71
I am spending a lot more time taking care of children	138	81.18	126	88.73	74	77.08
I do not feeling like eating; my appetite was poor	33	19.41	16	16.90	16	16.67
My husband and I are fighting more	12	7.06	6	4.23	6	6.25
I am worried about my health	55	32.35	42	29.58	30	31.25
I am worried about the health of my baby	66	38.82	48	33.80	34	35.42
I am bothered by things that didn't usually bother me	51	30.00	25	17.61	13	13.54
The environment in my home is tense	29	17.16	36	25.35	12	12.50

Notes: This table presents the n and % for the respondents answering yes to the components of the mental well-being index, shown by the core dyads they belong to

Appendix B

Chapter 3 – Supplementary Tables and Figures

B.1 Tables

Table B.1: Phase-wise sample

	Baseline		Midline		Endline	
Phase	Villages	Households	Villages	Households	Villages	Households
1	66	479	56	354	65	442
2	59	497	58	447	59	445
3	65	576	64	476	65	494
4	51	442	51	399	51	361
5	55	415	54	353	52	295

Notes: This table presents the phase-wise sample for baseline, midlne and endline

Table B.2: Daughter-in-law summary statistics in baseline sample (N=2,409)

	Control (n=664)		T1: Individual + Only DIL (n=455)		T2: Individual + DIL&MIL (n=442)		T3:Group + Only DIL (n=421)		T4: Group + DIL&MIL (n=427)	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Daughter-in-law characteristics										
Age at baseline	23.131	3.062	23.547	3.410	23.532	3.235	23.333	3.228	23.3	3.374
Years of schooling completed	9.039	3.491	8.657	3.474	8.425	3.298	8.77	3.412	8.593	3.59
Religion: Hindu	0.959	0.198	0.982	0.132	0.989	0.106	0.986	0.119	0.991	0.096
Social category: General	0.089	0.285	0.073	0.260	0.075	0.263	0.078	0.269	0.07	0.256
Social category: Scheduled caste/ Scheduled tribe	0.334	0.472	0.409	0.492	0.353	0.478	0.352	0.478	0.349	0.477
Social category: Other backward castes	0.550	0.498	0.424	0.495	0.511	0.5	0.482	0.5	0.52	0.5
Currently working outside the home	0.142	0.349	0.200	0.400	0.19	0.393	0.216	0.412	0.183	0.387
Household characteristics										
Total permanent household members	5.360	1.678	5.424	1.705	5.473	1.818	5.278	1.526	5.41	1.774
Household head is the mother-in-law	0.166	0.372	0.165	0.371	0.176	0.382	0.152	0.359	0.148	0.355
Household head is the father-in-law	0.166	0.372	0.165	0.371	0.176	0.382	0.152	0.359	0.148	0.355
Monthly household income < ₹2000 ($24)	0.444	0.497	0.468	0.500	0.446	0.498	0.475	0.5	0.482	0.5
Husband characteristics										
Husband's age	25.915	3.555	26.284	3.618	26.35	4.083	26.233	3.676	26.211	3.626
Husband's years of schooling completed	9.968	3.555	9.453	3.471	9.357	3.393	9.834	3.323	9.487	3.498
Husband's occupation:										
Daily wage worker	0.201	0.401	0.215	0.412	0.191	0.393	0.164	0.371	0.173	0.379
Agricultural worker	0.480	0.500	0.560	0.497	0.568	0.496	0.637	0.482	0.628	0.484
Migrant worker	0.154	0.361	0.073	0.260	0.091	0.288	0.086	0.28	0.07	0.256
Public sector employee	0.015	0.122	0.013	0.114	0.014	0.116	0.007	0.084	0.009	0.096
Private sector employee	0.095	0.293	0.088	0.283	0.09	0.287	0.067	0.249	0.056	0.231
Unemployed	0.032	0.175	0.029	0.167	0.018	0.134	0.026	0.16	0.04	0.196
Marriage characteristics										
Number of years married at baseline	3.612	3.151	3.640	3.403	3.627	3.337	3.47	3.122	3.527	3.212
Knew husband before marriage	0.270	0.444	0.231	0.422	0.215	0.411	0.185	0.389	0.218	0.413
Husband lives in the same household for at least 9 months in a year	0.965	0.183	0.974	0.160	0.975	0.156	0.964	0.186	0.958	0.201
Spend less than 6 hours alone with husband in a day	0.803	0.398	0.798	0.402	0.819	0.385	0.815	0.389	0.773	0.419
Husband spends less than 6 hours at home in a day	0.675	0.469	0.571	0.495	0.604	0.49	0.589	0.493	0.546	0.498
Husband discusses work often	0.503	0.500	0.543	0.499	0.523	0.5	0.518	0.5	0.562	0.497
Husband discusses community issues often	0.419	0.494	0.431	0.496	0.403	0.491	0.442	0.497	0.461	0.499
Husband discusses family issues often	0.544	0.498	0.565	0.496	0.55	0.498	0.546	0.498	0.574	0.495
Husband discusses family planning often	0.571	0.495	0.578	0.494	0.572	0.495	0.549	0.498	0.567	0.496

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Fertility history												
Been pregnant before	0.443	0.497	0.442	0.497	0.443	0.497	0.454	0.498	0.44	0.497		
Number of previous pregnancies	1.520	0.817	1.478	0.889	1.597	0.926	1.524	0.832	1.495	0.862		
Pregnancy ended in a live birth	0.422	0.494	0.431	0.496	0.434	0.496	0.442	0.497	0.426	0.495		
Pregnancy ended in a stillbirth	0.027	0.163	0.018	0.132	0.009	0.095	0.024	0.152	0.014	0.118		
Pregnancy ended in a miscarriage	0.003	0.055	0.004	0.066	0.005	0.067	0	0	0.005	0.068		
Pregnancy ended in an abortion	0.003	0.055	0.002	0.047	0.000	0.000	0.002	0.049	0.002	0.048		
Number of alive children	0.633	0.911	0.635	0.931	0.699	0.998	0.656	0.922	0.63	0.921		
Health-seeking during most recent live birth												
Number of antenatal care (ANC) visits completed	1.615	2.351	1.196	0.979	1.204	1.157	1.319	0.923	1.344	1.391		
Paid for ANC visit	0.436	0.497	0.462	0.500	0.422	0.495	0.412	0.494	0.431	0.497		
Current pregnancy												
Gestational age at baseline (in months)	4.661	1.184	4.577	1.139	4.502	1.182	4.467	1.271	4.478	1.273		
Pregnancy is registered with healthcare worker	0.931	0.254	0.905	0.293	0.939	0.24	0.933	0.249	0.927	0.26		
Receiveda Mother and Child Protection (MCP) Card	0.814	0.389	0.784	0.412	0.778	0.416	0.822	0.383	0.788	0.409		
Gone for any ANC visits	0.836	0.371	0.785	0.412	0.778	0.416	0.8	0.4	0.838	0.369		
Number of ANC visits compeleted at baseline	1.392	0.951	1.242	0.904	1.260	0.958	1.247	0.887	1.290	0.88		
ANC Knowledge Index												
Correctly identified ANC is important for detecting complications for the mother	0.690	0.463	0.686	0.465	0.688	0.464	0.715	0.452	0.7	0.459		
Correctly identified ANC is important for detecting complications for the fetus	0.735	0.442	0.697	0.460	0.69	0.463	0.675	0.469	0.7	0.459		
Correctly identified ANC is important for early intervention	0.611	0.488	0.569	0.496	0.618	0.487	0.575	0.495	0.581	0.494		
Correctly identified total number of ANC visits recommended	0.742	0.438	0.640	0.481	0.661	0.474	0.658	0.475	0.658	0.475		
Know about the Janani Shishu Suraksha (JSS) government benefit	0.795	0.404	0.653	0.477	0.681	0.467	0.696	0.461	0.719	0.45		
Know the date of the Village Health and Nutrition Day (VHND)	0.803	0.398	0.745	0.436	0.742	0.438	0.774	0.419	0.768	0.423		
Correctly identified riskier pregnancy in first described situation	0.732	0.443	0.723	0.448	0.742	0.438	0.758	0.429	0.698	0.46		
Correctly identified riskier pregnancy in second described situation	0.387	0.487	0.376	0.485	0.346	0.476	0.38	0.486	0.386	0.487		
Know the cost of an ANC visit	0.923	0.266	0.947	0.224	0.959	0.198	0.952	0.213	0.906	0.292		

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Iron and Folic Acid (IFA) Knowledge Index										
Correctly identified the use of IFA supplements for blood volume	0.911	0.285	0.864	0.343	0.887	0.317	0.91	0.287	0.906	0.292
Correctly identified the use of IFA supplements to treat anemia	0.444	0.497	0.462	0.499	0.441	0.497	0.508	0.501	0.513	0.5
Know the risk of untreated anemia	0.902	0.297	0.824	0.381	0.86	0.348	0.808	0.395	0.794	0.405
Know the importance of IFA supplementation	0.651	0.477	0.653	0.477	0.643	0.48	0.646	0.479	0.637	0.481
Permission needed from husband on the following:										
Buy clothing for yourself	0.833	0.373	0.846	0.361	0.857	0.35	0.872	0.335	0.867	0.341
Buy things in the market	0.846	0.361	0.855	0.353	0.86	0.348	0.876	0.329	0.859	0.348
Visit a family planning clinic	0.875	0.331	0.870	0.336	0.86	0.348	0.881	0.324	0.857	0.35
Meet the ASHA worker	0.848	0.359	0.859	0.348	0.855	0.352	0.891	0.312	0.885	0.319
Visit the home of friends by yourself	0.870	0.336	0.897	0.305	0.907	0.29	0.912	0.283	0.946	0.226
Travel a short distance by bus or train or other public transport	0.893	0.309	0.901	0.299	0.9	0.3	0.907	0.29	0.911	0.285
Visit your maternal home	0.908	0.289	0.919	0.274	0.928	0.259	0.91	0.287	0.923	0.267
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.919	0.274	0.910	0.287	0.912	0.284	0.903	0.297	0.923	0.267
Permission needed from the mother-in-law on the following:										
Buy clothing for yourself	0.825	0.380	0.846	0.361	0.842	0.366	0.862	0.345	0.857	0.35
Buy things in the market	0.836	0.371	0.853	0.355	0.857	0.35	0.86	0.348	0.85	0.357
Visit a family planning clinic	0.848	0.359	0.848	0.359	0.848	0.359	0.86	0.348	0.855	0.353
Meet the ASHA worker	0.837	0.369	0.848	0.359	0.846	0.361	0.876	0.329	0.874	0.333
Visit the home of friends by yourself	0.864	0.343	0.888	0.316	0.91	0.287	0.922	0.269	0.932	0.252
Travel a short distance by bus or train or other public transport	0.886	0.319	0.903	0.296	0.91	0.287	0.914	0.28	0.913	0.282
Visit your maternal home	0.911	0.285	0.901	0.299	0.928	0.259	0.914	0.28	0.916	0.278
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.920	0.271	0.908	0.290	0.919	0.274	0.91	0.287	0.916	0.278
Restrictive relationship with mother-in-law										
MIL limits contact with female friends	0.511	0.500	0.607	0.489	0.563	0.497	0.627	0.484	0.6	0.491
MIL limits contact with maternal household members	0.474	0.500	0.587	0.493	0.552	0.498	0.582	0.494	0.578	0.494
Cannot discuss issues relating to your health or women's health in general with MIL	0.220	0.414	0.152	0.359	0.149	0.357	0.152	0.359	0.171	0.377
MIL gets upset if you disagree with her on something	0.431	0.496	0.578	0.494	0.57	0.496	0.553	0.498	0.576	0.495
Feel nervous discussing issues or arguing with MIL	0.432	0.496	0.481	0.500	0.493	0.501	0.416	0.493	0.426	0.495

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Adherence to social norms												
A woman's most important role is to be a good homemaker	0.878	0.328	0.886	0.319	0.889	0.314	0.924	0.265	0.906	0.292		
It is not good for pregnant women to be seen alone in public	0.822	0.383	0.807	0.395	0.846	0.361	0.853	0.355	0.848	0.36		
A woman should tolerate violence to keep the family together	0.527	0.500	0.571	0.495	0.577	0.495	0.589	0.493	0.6	0.491		
A daughter-in-law should not argue with her mother-in-law	0.837	0.369	0.824	0.381	0.857	0.35	0.867	0.34	0.857	0.35		
A daughter-in-law should listen to her mother-in-law regarding maternal health issues	0.926	0.262	0.936	0.245	0.952	0.213	0.931	0.254	0.937	0.244		
Women should be able to travel on their own to health centers	0.133	0.339	0.171	0.377	0.176	0.382	0.081	0.273	0.126	0.333		

This table presents the means and standard deviations of daughters-in-law reported covariates in the control and treatment groups at baseline, prior to any intervention and post-randomization. For binary characteristics, it shows the proportion of daughters-in-law.

Table B.3: Baseline covariate balance of baseline sample (DIL responses only) (N=2,409)

	Pairwise differences *p*-values							
	Control vs. T1	Control vs. T2	Control vs.T3	Control vs.T4	T1 vs.T2	T3 vs. T4	T1 vs. T3	T2 vs.T4
Daughter-in-law characteristics								
Age at baseline	0.601	0.404	0.5	0.938	0.765	0.89	0.375	0.746
Years of schooling completed	0.225	0.011 **	0.73	0.756	0.149	0.35	0.245	0.49
Religion: Hindu	0.283	0.126	0.072 *	0.054 *	0.42	0.65	0.549	0.675
Social category: General	0.303	0.486	0.52	0.501	0.884	0.48	0.543	0.852
Social category: Scheduled caste/ Scheduled tribe	0.034 **	0.704	0.713	0.953	0.046 **	0.75	0.254	0.5
Social category: Other backward castes	0.011 **	0.62	0.71	0.761	0.019 **	0.25	0.148	0.739
Currently working outside the home	0.546	0.546	0.534	0.446	0.881	0.46	0.314	0.374
Household characteristics								
Total permanent household members	0.881	0.888	0.94	0.645	0.393	0.4	0.576	0.464
Household head is the mother-in-law	0.974	0.486	0.457	0.989	0.774	0.72	0.881	0.232
Household head is the father-in-law	0.326	0.21	0.212	0.631	0.856	0.2	0.607	0.074 *
Monthly household income < ₹2000 ($24)	0.241	0.32	0.188	0.268	0.757	0.58	0.572	0.784
Husband characteristics								
Husband's age	0.842	0.582	0.809	0.457	0.67	0.71	0.956	0.879
Husband's years of schooling completed	0.012 **	0.002 ***	0.936	0.311	0.753	0.13	0.057 *	0.444
Husband's occupation:								
Daily wage worker	0.082 *	0.375	0.445	0.41	0.188	0.81	0.401	0.948
Agricultural worker	0.418	0.302	0.007 ***	0.015 **	0.782	0.71	0.427	0.268
Migrant worker	0.005 ***	0.114	0.019 **	0.013 **	0.164	0.32	0.485	0.559
Public sector employee	0.716	0.922	0.083 *	0.494	0.716	0.85	0.643	0.465
Private sector employee	0.901	0.98	0.269	0.093 *	0.983	0.4	0.551	0.062 *
Unemployed	0.469	0.237	0.568	0.563	0.554	0.41	0.9	0.063 *
Marriage characteristics								
Number of years married at baseline	0.974	0.911	0.012 **	0.456	0.928	0.57	0.178	0.693
Knew husband before marriage	0.019 **	0.022 **	0.206	0.642	0.889	0.23	0.104	0.047 **
Husband lives in the same household for at least 9 months in a year	0.248	0.224	0.85	0.784	0.961	0.85	0.264	0.113
Spend less than 6 hours alone with husband in a day	0.661	0.98	0.629	0.293	0.621	0.14	0.522	0.521
Husband spends less than 6 hours at home in a day	0.17	0.479	0.081 *	0.088 *	0.046 **	0.21	0.682	0.404
Husband discusses work often	0.022 **	0.093 *	0.045 **	0.017 **	0.381	0.22	0.519	0.644
Husband discusses community issues often	0.061 *	0.108	0.02 **	0.02 **	0.54	0.83	0.932	0.449
Husband discusses family issues often	0.205	0.245	0.016 **	0.026 **	0.749	0.94	0.873	0.583
Husband discusses family planning often	0.028 **	0.026 **	0.046 **	0.039 **	0.958	0.81	0.478	0.603

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Fertility history										
Been pregnant before	0.339	0.46	0.353	0.883	0.77	0.61	0.885	0.861		
Number of previous pregnancies	0.798	0.127	0.908	0.94	0.16	0.56	0.911	0.268		
Pregnancy ended in a live birth	0.659	0.259	0.239	0.771	0.874	0.73	0.85	0.208		
Pregnancy ended in a stillbirth	0.846	0.023 **	0.473	0.244	0.212	0.27	0.667	0.48		
Pregnancy ended in a miscarriage	0.467	0.435	0.177	0.755	0.91	0.17	0.164	0.534		
Pregnancy ended in an abortion	0.608	0.276	0.697	0.739	0.352	0.91	0.833	0.297		
Number of alive children	0.841	0.023 **	0.884	0.561	0.146	0.97	0.77	0.039 **		
Health-seeking during most recent live birth										
Number of antenatal care (ANC) visits completed	0.047 **	0.118	0.254	0.502	0.616	0.63	0.283	0.426		
Paid for ANC visit	0.822	0.346	0.547	0.62	0.052 *	0.62	0.433	0.935		
Current pregnancy										
Gestational age at baseline (in months)	0.44	0.779	0.657	0.955	0.567	0.96	0.984	0.593		
Pregnancy is registered with healthcare worker	0.046 **	0.625	0.803	0.638	0.011 **	0.71	0.01 **	0.966		
Receiveda Mother and Child Protection (MCP) Card	0.07 *	0.041 **	0.338	0.055 *	0.837	0.11	0.325	0.895		
Gone for any ANC visits	0.046 **	0.059 *	0.536	0.757	0.904	0.07 *	0.172	0.063 *		
Number of ANC visits compeleted at baseline	0.079 *	0.271	0.259	0.489	0.413	0.46	0.515	0.687		
ANC Knowledge Index										
Correctly identified ANC is important for detecting complications for the mother	0.532	0.306	0.357	0.735	0.754	0.51	0.683	0.832		
Correctly identified ANC is important for detecting complications for the fetus	0.608	0.844	0.326	0.728	0.968	0.37	0.522	0.757		
Correctly identified ANC is important for early intervention	0.06 *	0.193	0.176	0.203	0.009 ***	0.78	0.449	0.888		
Correctly identified total number of ANC visits recommended	0.007 ***	0.012 **	0.025 **	0.018 **	0.364	0.83	0.822	0.802		
Know about the Janani Shishu Suraksha (JSS) government benefit	0.003 ***	0.013 **	0.002 ***	0.021 **	0.149	0.14	0.77	0.537		
Know the date of the Village Health and Nutrition Day (VHND)	0.047 **	0.045 **	0.105	0.061 *	0.972	0.72	0.404	0.752		
Correctly identified riskier pregnancy in first described situation	0.151	0.089 *	0.689	0.146	0.468	0.05 *	0.325	0.921		
Correctly identified riskier pregnancy in second described situation	0.574	0.085 *	0.298	0.261	0.27	0.88	0.766	0.454		
Know the cost of an ANC visit	0.314	0.131	0.193	0.812	0.462	0 ***	0.979	0.05 *		

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Iron and Folic Acid (IFA) Knowledge Index										
Correctly identified the use of IFA supplements for blood volume	0.062 *	0.236	0.14	0.132	0.376	0.72	0.187	0.443		
Correctly identified the use of IFA supplements to treat anemia	0.652	0.706	0.653	0.4	0.886	0.76	0.353	0.106		
Know the risk of untreated anemia	0.402	0.59	0.231	0.098 *	0.204	0.3	0.983	0.289		
Know the importance of IFA supplementation	0.448	0.625	0.117	0.146	0.557	0.92	0.886	0.946		
Permission needed from husband on the following:										
Buy clothing for yourself	0.456	0.769	0.62	0.196	0.639	0.85	0.733	0.313		
Buy things in the market	0.332	0.408	0.61	0.041 **	0.915	0.48	0.684	0.245		
Visit a family planning clinic	0.378	0.059 *	0.262	0.012 **	0.209	0.47	0.423	0.225		
Meet the ASHA worker	0.604	0.268	0.979	0.611	0.477	0.77	0.988	0.665		
Visit the home of friends by yourself	0.946	0.563	0.498	0.087 *	0.56	0.01 ***	0.437	0.155		
Travel a short distance by bus or train or other public transport	0.923	0.894	0.954	0.433	0.971	0.51	0.427	0.929		
Visit your maternal home	0.982	0.55	0.257	0.839	0.478	0.22	0.067 *	0.294		
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.559	0.614	0.068 *	0.775	0.712	0.03 **	0.128	0.827		
Permission needed from the mother-in-law on the following:										
Buy clothing for yourself	0.655	0.278	0.433	0.081 *	0.35	0.74	0.531	0.511		
Buy things in the market	0.571	0.662	0.294	0.041 **	0.893	0.86	0.268	0.238		
Visit a family planning clinic	0.594	0.442	0.185	0.217	0.783	0.43	0.436	0.673		
Meet the ASHA worker	0.587	0.267	0.406	0.224	0.513	0.48	0.695	0.934		
Visit the home of friends by yourself	0.849	0.31	0.567	0.298	0.136	0.36	0.761	0.851		
Travel a short distance by bus or train or other public transport	0.613	0.327	0.368	0.074 *	0.67	0.74	0.736	0.831		
Visit your maternal home	0.203	0.736	0.34	0.698	0.037 **	0.45	0.543	0.206		
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.417	0.978	0.186	0.924	0.224	0.44	0.311	0.655		
Restrictive relationship with mother-in-law										
MIL limits contact with female friends	0.488	0.091 *	0.274	0.827	0.276	0.31	0.309	0.154		
MIL limits contact with maternal household members	0.941	0.269	0.439	0.299	0.307	0.56	0.966	0.198		
Cannot discuss issues relating to your health or women's health in general with MIL	0.485	0.254	0.074 *	0.246	0.836	0.24	0.955	0.488		
MIL gets upset if you disagree with her on something	0.173	0.224	0.021 **	0.019 **	0.583	0.79	0.951	0.6		
Feel nervous discussing issues or arguing with MIL	0.516	0.444	0.895	0.498	0.807	0.92	0.904	0.855		

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Adherence to social norms										
A woman's most important role is to be a good homemaker	0.333	0.132	0.204	0.401	0.465	0.35	0.874	0.87		
It is not good for pregnant women to be seen alone in public	0.904	0.226	0.956	0.903	0.049 **	0.99	0.683	0.605		
A woman should tolerate violence to keep the family together	0.343	0.236	0.759	0.363	0.911	0.33	0.735	0.62		
A daughter-in-law should not argue with her mother-in-law	0.592	0.258	0.751	0.978	0.348	0.85	0.758	0.439		
A daughter-in-law should listen to her mother-in-law regarding maternal health issues	0.867	0.639	0.375	0.955	0.447	0.23	0.206	0.247		
Women should be able to travel on their own to health centers	0.642	0.712	0.15	0.684	0.72	0.05 *	0.183	0.522		

The table includes two types of pairwise comparisons: the first set of p-values indicates significant differences between the control group and each treatment group, and the second set compares the treatment groups of interest for the analysis. The displayed p-values result from a regression of the dependent variable on an indicator variable for each treatment group, with the control vs. treatment groups and an indicator variable using the first treatment group specified as the reference category. Strata fixed effects are included, and standard errors are clustered at the village level (not shown here). * denotes statistical significance at 10 pct, ** at 5 pct, and *** at 1 pct level.

Table B.4: Daughter-in-law summary statistics in midline sample (N=1,991)

	Control (n=511)		T1: Individual + Only DIL (n=390)		T2: Individual + DIL&MIL (n=358)		T3:Group + Only DIL (n=365)		T4: Group + DIL&MIL (n=367)	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Daughter-in-law characteristics										
Age at baseline	23.043	3.017	23.595	3.397	23.372	3.033	23.189	3.142	23.237	3.413
Years of schooling completed	8.9	3.431	8.764	3.464	8.648	3.217	8.781	3.484	8.695	3.615
Religion: Hindu	0.949	0.22	0.99	0.101	0.994	0.075	0.984	0.127	0.989	0.104
Social category: General	0.096	0.295	0.072	0.258	0.075	0.264	0.082	0.275	0.071	0.257
Social category: Scheduled caste/ Scheduled tribe	0.315	0.465	0.413	0.493	0.36	0.481	0.34	0.474	0.354	0.479
Social category: Other backward castes	0.564	0.496	0.433	0.496	0.52	0.5	0.51	0.501	0.523	0.5
Currently working outside the home	0.145	0.352	0.185	0.388	0.187	0.391	0.211	0.409	0.183	0.387
Household characteristics										
Total permanent household members	5.36	1.674	5.362	1.682	5.38	1.743	5.334	1.552	5.417	1.8
Household head is the mother-in-law	0.166	0.373	0.156	0.364	0.17	0.377	0.164	0.371	0.142	0.349
Household head is the father-in-law	0.166	0.373	0.156	0.364	0.17	0.377	0.164	0.371	0.142	0.349
Monthly household income < ₹2000 ($24)	0.489	0.5	0.454	0.499	0.447	0.498	0.452	0.498	0.463	0.499
Husband characteristics										
Husband's age	25.851	3.501	26.323	3.617	25.983	3.74	26.055	3.513	26.093	3.597
Husband's years of schooling completed	9.859	3.56	9.59	3.492	9.52	3.305	9.899	3.373	9.616	3.457
Husband's occupation:										
Daily wage worker	0.212	0.409	0.236	0.425	0.188	0.391	0.162	0.369	0.18	0.385
Agricultural worker	0.507	0.5	0.536	0.499	0.579	0.494	0.633	0.483	0.635	0.482
Migrant worker	0.134	0.341	0.072	0.258	0.084	0.278	0.09	0.287	0.063	0.243
Public sector employee	0.012	0.108	0.013	0.113	0.017	0.129	0.008	0.09	0.011	0.104
Private sector employee	0.094	0.292	0.092	0.29	0.087	0.282	0.071	0.258	0.052	0.222
Unemployed	0.028	0.164	0.026	0.158	0.014	0.118	0.022	0.147	0.038	0.192
Marriage characteristics										
Number of years married at baseline	3.585	3.157	3.654	3.497	3.43	3.146	3.427	3.071	3.499	3.225
Knew husband before marriage	0.272	0.445	0.223	0.417	0.212	0.41	0.186	0.39	0.215	0.412
Husband lives in the same household for at least 9 months in a year	0.971	0.169	0.977	0.15	0.986	0.118	0.967	0.179	0.965	0.185
Spend less than 6 hours alone with husband in a day	0.785	0.411	0.777	0.417	0.813	0.391	0.822	0.383	0.787	0.41
Husband spends less than 6 hours at home in a day	0.671	0.47	0.546	0.499	0.584	0.494	0.597	0.491	0.556	0.498
Husband discusses work often	0.509	0.5	0.564	0.497	0.528	0.5	0.521	0.5	0.564	0.497
Husband discusses community issues often	0.44	0.497	0.446	0.498	0.425	0.495	0.449	0.498	0.466	0.5
Husband discusses family issues often	0.569	0.496	0.572	0.495	0.539	0.499	0.542	0.499	0.578	0.495
Husband discusses family planning often	0.577	0.494	0.59	0.493	0.581	0.494	0.542	0.499	0.559	0.497

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Fertility history												
Been pregnant before	0.44	0.497	0.436	0.497	0.416	0.494	0.449	0.498	0.436	0.497		
Number of previous pregnancies	1.524	0.808	1.494	0.905	1.537	0.927	1.512	0.787	1.475	0.839		
Pregnancy ended in a live birth	0.419	0.494	0.428	0.495	0.405	0.492	0.441	0.497	0.42	0.494		
Pregnancy ended in a stillbirth	0.027	0.163	0.018	0.133	0.011	0.105	0.022	0.147	0.016	0.127		
Pregnancy ended in a miscarriage	0.004	0.062	0.003	0.051	0.006	0.075	0	0	0.005	0.074		
Pregnancy ended in an abortion	0.004	0.062	0	0	0	0	0.003	0.052	0.003	0.052		
Number of alive children	0.636	0.912	0.638	0.94	0.628	0.955	0.647	0.892	0.605	0.89		
Health-seeking during most recent live birth												
Number of antenatal care (ANC) visits completed	1.375	1.673	1.184	1.026	1.215	1.288	1.325	0.967	1.289	1.286		
Paid for ANC visit	0.423	0.495	0.414	0.494	0.408	0.493	0.42	0.495	0.422	0.496		
Current pregnancy												
Gestational age at baseline (in months)	4.595	1.189	4.571	1.142	4.478	1.173	4.423	1.257	4.387	1.277		
Pregnancy is registered with healthcare worker	0.918	0.275	0.903	0.297	0.933	0.25	0.934	0.248	0.924	0.266		
Receiveda Mother and Child Protection (MCP) Card	0.795	0.404	0.776	0.418	0.769	0.422	0.836	0.371	0.785	0.412		
Gone for any ANC visits	0.826	0.38	0.782	0.413	0.76	0.428	0.792	0.407	0.826	0.38		
Number of ANC visits compeleted at baseline	1.362	0.952	1.256	0.916	1.246	0.982	1.211	0.866	1.232	0.864		
ANC Knowledge Index												
Correctly identified ANC is important for detecting complications for the mother	0.701	0.458	0.682	0.466	0.687	0.464	0.696	0.461	0.711	0.454		
Correctly identified ANC is important for detecting complications for the fetus	0.763	0.426	0.692	0.462	0.682	0.467	0.658	0.475	0.711	0.454		
Correctly identified ANC is important for early intervention	0.613	0.488	0.577	0.495	0.626	0.485	0.581	0.494	0.597	0.491		
Correctly identified total number of ANC visits recommended	0.767	0.423	0.659	0.475	0.676	0.469	0.677	0.468	0.643	0.48		
Know about the Janani Shishu Suraksha (JSS) government benefit	0.798	0.402	0.649	0.478	0.687	0.464	0.682	0.466	0.7	0.459		
Know the date of the Village Health and Nutrition Day (VHND)	0.793	0.406	0.749	0.434	0.743	0.438	0.756	0.43	0.752	0.432		
Correctly identified riskier pregnancy in first described situation	0.746	0.436	0.705	0.457	0.737	0.441	0.77	0.421	0.7	0.459		
Correctly identified riskier pregnancy in second described situation	0.37	0.483	0.374	0.485	0.344	0.476	0.395	0.489	0.39	0.488		
Know the cost of an ANC visit	0.914	0.281	0.949	0.221	0.953	0.213	0.953	0.211	0.907	0.29		

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Permission needed from husband on the following:												
Buy clothing for yourself	0.845	0.362	0.841	0.366	0.866	0.341	0.866	0.341	0.869	0.338		
Buy things in the market	0.857	0.35	0.849	0.359	0.866	0.341	0.871	0.335	0.864	0.344		
Visit a family planning clinic	0.896	0.305	0.862	0.346	0.866	0.341	0.874	0.332	0.864	0.344		
Meet the ASHA worker	0.867	0.34	0.851	0.356	0.855	0.353	0.89	0.313	0.894	0.309		
Visit the home of friends by yourself	0.881	0.325	0.897	0.304	0.911	0.286	0.907	0.291	0.94	0.238		
Travel a short distance by bus or train or other public transport	0.904	0.295	0.9	0.3	0.908	0.29	0.901	0.299	0.907	0.29		
Visit your maternal home	0.912	0.284	0.913	0.282	0.93	0.255	0.899	0.302	0.916	0.278		
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.933	0.249	0.908	0.29	0.922	0.269	0.899	0.302	0.918	0.274		
Permission needed from the mother-in-law on the following:												
Buy clothing for yourself	0.834	0.373	0.838	0.368	0.846	0.361	0.858	0.35	0.856	0.352		
Buy things in the market	0.845	0.362	0.846	0.361	0.86	0.347	0.855	0.353	0.847	0.36		
Visit a family planning clinic	0.869	0.338	0.844	0.364	0.858	0.35	0.855	0.353	0.861	0.346		
Meet the ASHA worker	0.847	0.36	0.836	0.371	0.852	0.356	0.877	0.329	0.877	0.328		
Visit the home of friends by yourself	0.867	0.34	0.885	0.32	0.916	0.277	0.915	0.279	0.929	0.257		
Travel a short distance by bus or train or other public transport	0.9	0.3	0.897	0.304	0.916	0.277	0.91	0.287	0.907	0.29		
Visit your maternal home	0.916	0.278	0.895	0.307	0.93	0.255	0.907	0.291	0.907	0.29		
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.933	0.249	0.903	0.297	0.927	0.26	0.907	0.291	0.91	0.286		
Restrictive relationship with mother-in-law												
MIL limits contact with female friends	0.503	0.5	0.59	0.493	0.573	0.495	0.641	0.48	0.621	0.486		
MIL limits contact with maternal household members	0.472	0.5	0.569	0.496	0.567	0.496	0.605	0.489	0.599	0.491		
Cannot discuss issues relating to your health or women's health in general with MIL	0.211	0.409	0.146	0.354	0.142	0.35	0.137	0.344	0.166	0.373		
MIL gets upset if you disagree with her on something	0.425	0.495	0.582	0.494	0.561	0.497	0.575	0.495	0.589	0.493		
Feel nervous discussing issues or arguing with MIL	0.434	0.496	0.459	0.499	0.48	0.5	0.416	0.494	0.425	0.495		

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Adherence to social norms													
A woman's most important role is to be a good homemaker	0.902	0.297		0.867	0.34		0.877	0.329		0.921	0.271		0.907	0.29		0.42	
It is not good for pregnant women to be seen alone in public	0.798	0.402		0.8	0.401		0.846	0.361		0.847	0.361		0.842	0.365		0.932	
A woman should tolerate violence to keep the family together	0.548	0.498		0.59	0.493		0.592	0.492		0.614	0.488		0.613	0.488		0.448	
A daughter-in-law should not argue with her mother-in-law	0.824	0.381		0.831	0.375		0.855	0.353		0.863	0.344		0.864	0.344		0.599	
A daughter-in-law should listen to her mother-in-law regarding maternal health issues	0.914	0.281		0.938	0.241		0.958	0.201		0.929	0.258		0.937	0.243		0.765	
Women should be able to travel on their own to health centers	0.1	0.3		0.177	0.382		0.165	0.372		0.088	0.283		0.134	0.341		0.592	

This table presents the means and standard deviations of daughters-in-law reported covariates in the control and treatment groups at baseline, prior to any intervention and post-randomization. For binary characteristics, it shows the proportion of daughters-in-law.

Table B.5: Baseline covariate balance of midline sample (DIL responses only) (N=1,991)

	Pairwise differences *p*-values							
	Control vs. T1	Control vs. T2	Control vs.T3	Control vs.T4	T1 vs.T2	T3 vs. T4	T1 vs. T3	T2 vs.T4
Daughter-in-law characteristics								
Age at baseline	0.524	0.499	0.437	0.936	0.94	0.819	0.331	0.985
Years of schooling completed	0.396	0.039 **	0.589	0.967	0.189	0.422	0.301	0.592
Religion: Hindu	0.114	0.017 **	0.065 *	0.052 *	0.352	0.644	0.847	0.647
Social category: General	0.26	0.445	0.448	0.506	0.816	0.549	0.383	0.676
Social category: Scheduled caste/ Scheduled tribe	0.033 **	0.703	0.732	0.898	0.045 **	0.791	0.217	0.49
Social category: Other backward castes	0.012 **	0.636	0.791	0.682	0.021 **	0.293	0.14	0.63
Currently working outside the home	0.923	0.553	0.475	0.374	0.839	0.437	0.344	0.373
Household characteristics								
Total permanent household members	0.808	0.958	0.99	0.625	0.342	0.449	0.452	0.412
Household head is the mother-in-law	0.772	0.436	0.676	0.663	0.587	0.716	0.848	0.067 *
Household head is the father-in-law	0.441	0.213	0.422	0.382	0.98	0.255	0.505	0.029 **
Monthly household income < ₹2000 ($24)	0.517	0.841	0.32	0.495	0.525	0.576	0.545	0.61
Husband characteristics								
Husband's age	0.764	0.79	0.675	0.509	0.915	0.646	0.83	0.637
Husband's years of schooling completed	0.039 **	0.009 ***	0.708	0.54	0.724	0.146	0.086 *	0.54
Husband's occupation:								
Daily wage worker	0.144	0.605	0.684	0.593	0.159	0.825	0.4	0.963
Agricultural worker	0.471	0.235	0.006 ***	0.013 **	0.58	0.638	0.426	0.382
Migrant worker	0.009 ***	0.095 *	0.036 **	0.026 **	0.333	0.309	0.443	0.835
Public sector employee	0.923	0.935	0.117	0.666	0.724	0.857	0.637	0.455
Private sector employee	0.765	0.773	0.293	0.105	0.886	0.34	0.554	0.035 **
Unemployed	0.523	0.247	0.583	0.492	0.566	0.406	0.817	0.07 *
Marriage characteristics								
Number of years married at baseline	0.904	0.545	0.006 ***	0.375	0.71	0.58	0.183	0.923
Knew husband before marriage	0.017 **	0.024 **	0.184	0.562	0.949	0.262	0.11	0.066 *
Husband lives in the same household for at least 9 months in a year	0.284	0.08 *	0.919	0.731	0.282	0.847	0.276	0.01 **
Spend less than 6 hours alone with husband in a day	0.584	0.901	0.546	0.329	0.653	0.259	0.627	0.607
Husband spends less than 6 hours at home in a day	0.153	0.369	0.092 *	0.089 *	0.066 *	0.201	0.634	0.474
Husband discusses work often	0.024 **	0.124	0.067 *	0.03 **	0.234	0.223	0.457	0.635
Husband discusses community issues often	0.084 *	0.133	0.034 **	0.034 **	0.536	0.829	0.978	0.543
Husband discusses family issues often	0.201	0.263	0.026 **	0.041 **	0.594	0.945	0.946	0.55
Husband discusses family planning often	0.025 **	0.034 **	0.062 *	0.048 **	0.715	0.806	0.433	0.634

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Fertility history										
Been pregnant before	0.842	0.665	0.995	0.407	0.813	0.588	0.767	0.482		
Number of previous pregnancies	0.663	0.334	0.662	0.88	0.25	0.583	0.951	0.379		
Pregnancy ended in a live birth	0.609	0.283	0.233	0.753	0.902	0.745	0.86	0.207		
Pregnancy ended in a stillbirth	0.864	0.025	**	0.444	0.235	0.22	0.259	0.64	0.477	
Pregnancy ended in a miscarriage	0.533	0.443	0.162	0.825	0.878	0.173	0.163	0.529		
Pregnancy ended in an abortion	0.613	0.301	0.68	0.716	0.351	0.932	0.79	0.294		
Number of alive children	0.963	0.112	0.885	0.813	0.227	0.96	0.784	0.072	*	
Health-seeking during most recent live birth										
Number of antenatal care (ANC) visits completed	0.116	0.211	0.853	0.689	0.72	0.587	0.301	0.423		
Paid for ANC visit	1	0.22	0.416	0.488	0.059	*	0.53	0.398	0.897	
Current pregnancy										
Gestational age at baseline (in months)	0.478	0.115	0.699	0.339	0.346	0.742	0.324	0.728		
Pregnancy is registered with healthcare worker	0.067	*	0.664	0.758	0.714	0.016	**	0.715	0.012	**	0.978
Receiveda Mother and Child Protection (MCP) Card	0.089	*	0.041	**	0.402	0.071	*	0.788	0.108	0.331	0.957	
Gone for any ANC visits	0.101	0.095	*	0.704	0.556	0.867	0.066	*	0.229	0.051	*	
Number of ANC visits compeleted at baseline	0.193	0.452	0.443	0.797	0.518	0.463	0.582	0.58		
ANC Knowledge Index										
Correctly identified ANC is important for detecting complications for the mother	0.55	0.415	0.461	0.895	0.885	0.492	0.682	0.909		
Correctly identified ANC is important for detecting complications for the fetus	0.458	0.684	0.301	0.677	0.952	0.341	0.59	0.739		
Correctly identified ANC is important for early intervention	0.068	*	0.193	0.144	0.208	0.011	**	0.649	0.528	0.848		
Correctly identified total number of ANC visits recommended	0.005	***	0.009	***	0.013	**	0.011	**	0.385	0.828	0.79	0.868		
Know about the Janani Shishu Suraksha (JSS) government benefit	0.006	***	0.029	**	0.004	***	0.035	**	0.17	0.162	0.787	0.524		
Know the date of the Village Health and Nutrition Day (VHND)	0.069	*	0.05	*	0.155	0.097	*	0.91	0.698	0.371	0.612			
Correctly identified riskier pregnancy in first described situation	0.135	0.075	*	0.641	0.122	0.525	0.027	**	0.277	0.853				
Correctly identified riskier pregnancy in second described situation	0.787	0.171	0.471	0.395	0.343	0.722	0.699	0.514		
Know the cost of an ANC visit	0.298	0.119	0.158	0.886	0.464	0.004	***	0.993	0.052	*		

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Iron and Folic Acid (IFA) Knowledge Index										
Correctly identified the use of IFA supplements for blood volume	0.086	*	0.279	0.208	0.193	0.48	0.686	0.185	0.386	
Correctly identified the use of IFA supplements to treat anemia	0.796		0.794	0.615	0.375	0.856	0.732	0.4	0.119	
Know the risk of untreated anemia	0.444		0.648	0.266	0.13	0.193	0.323	0.95	0.274	
Know the importance of IFA supplementation	0.428		0.557	0.106	0.153	0.602	0.984	0.836	0.829	
Permission needed from husband on the following:										
Buy clothing for yourself	0.55		0.772	0.916	0.353	0.807	0.908	0.744	0.375	
Buy things in the market	0.379		0.452	0.962	0.099	* 0.899	0.426	0.736	0.284	
Visit a family planning clinic	0.318		0.07	* 0.333	0.016	** 0.257	0.441	0.419	0.202	
Meet the ASHA worker	0.508		0.21	0.879	0.601	0.449	0.796	0.988	0.639	
Visit the home of friends by yourself	0.918		0.542	0.578	0.072	* 0.568	0.004	*** 0.354	0.154	
Travel a short distance by bus or train or other public transport	0.76		0.636	0.781	0.31	0.922	0.474	0.309	0.864	
Visit your maternal home	0.925		0.541	0.343	0.977	0.309	0.2	0.092	* 0.346	
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.687		0.827	0.108	0.58	0.638	0.025	** 0.08	* 0.905	
Permission needed from the mother-in-law on the following:										
Buy clothing for yourself	0.675		0.306	0.691	0.127	0.335	0.879	0.556	0.477	
Buy things in the market	0.547		0.6	0.453	0.052	* 0.878	0.739	0.273	0.211	
Visit a family planning clinic	0.695		0.61	0.286	0.298	0.9	0.444	0.375	0.514	
Meet the ASHA worker	0.496		0.19	0.438	0.19	0.467	0.48	0.689	0.892	
Visit the home of friends by yourself	0.929		0.298	0.461	0.228	0.14	0.303	0.916	0.979	
Travel a short distance by bus or train or other public transport	0.521		0.209	0.287	0.042	** 0.478	0.648	0.608	0.59	
Visit your maternal home	0.208		0.782	0.406	0.885	0.039	** 0.358	0.466	0.212	
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.449		0.857	0.256	0.92	0.109	0.366	0.253	0.415	
Restrictive relationship with mother-in-law										
MIL limits contact with female friends	0.511		0.104	0.268	0.751	0.276	0.342	0.291	0.105	
MIL limits contact with maternal household members	0.921		0.319	0.462	0.284	0.376	0.472	0.972	0.186	
Cannot discuss issues relating to your health or women's health in general with MIL	0.577		0.353	0.086	* 0.281	0.886	0.255	0.919	0.569	
MIL gets upset if you disagree with her on something	0.213		0.282	0.022	** 0.018	** 0.527	0.762	0.932	0.436	
Feel nervous discussing issues or arguing with MIL	0.503		0.431	0.98	0.523	0.786	0.904	0.952	0.94	

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Adherence to social norms									
A woman's most important role is to be a good homemaker	0.42	0.211	0.273	0.487	0.503	0.341	0.792	0.993	
It is not good for pregnant women to be seen alone in public	0.932	0.19	0.896	0.871	0.038 **	0.968	0.641	0.633	
A woman should tolerate violence to keep the family together	0.448	0.279	0.888	0.488	0.946	0.324	0.704	0.709	
A daughter-in-law should not argue with her mother-in-law	0.599	0.281	0.614	0.878	0.421	0.787	0.62	0.425	
A daughter-in-law should listen to her mother-in-law regarding maternal health issues	0.765	0.709	0.299	0.844	0.356	0.235	0.217	0.198	
Women should be able to travel on their own to health centers	0.592	0.586	0.23	0.87	0.628	0.052 *	0.227	0.561	

The table includes two types of pairwise comparisons: the first set of p-values indicates significant differences between the control group and each treatment group, and the second set compares the treatment groups of interest for the analysis. The displayed p-values result from a regression of the dependent variable on an indicator variable for each treatment group, with the control vs. treatment groups and an indicator variable using the first treatment group specified as the reference category. Strata fixed effects are included, and standard errors are clustered at the village level (not shown here). * denotes statistical significance at 10 pct, ** at 5 pct, and *** at 1 pct level.

Table B.6: Daughter-in-law summary statistics in endline sample (N=1,844)

	Control (n=444)		T1: Individual + Only DIL (n=361)		T2: Individual + DIL&MIL (n=361)		T3:Group + Only DIL (n=333)		T4: Group + DIL&MIL (n=345)	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Daughter-in-law characteristics										
Age at baseline	23.182	3.092	23.579	3.446	23.499	3.076	23.402	3.202	23.307	3.404
Years of schooling completed	8.829	3.533	8.765	3.514	8.673	3.077	8.793	3.43	8.577	3.697
Religion: Hindu	0.966	0.181	0.983	0.128	0.994	0.074	0.985	0.122	0.991	0.093
Social category: General	0.088	0.283	0.083	0.276	0.072	0.259	0.084	0.278	0.078	0.269
Social category: Scheduled caste/ Scheduled tribe	0.313	0.464	0.407	0.492	0.332	0.472	0.345	0.476	0.368	0.483
Social category: Other backward castes	0.574	0.495	0.449	0.498	0.54	0.499	0.505	0.501	0.519	0.5
Currently working outside the home	0.153	0.361	0.188	0.392	0.18	0.385	0.207	0.406	0.18	0.385
Household characteristics										
Total permanent household members	5.264	1.576	5.424	1.677	5.463	1.806	5.342	1.478	5.42	1.752
Household head is the mother-in-law	0.162	0.369	0.172	0.378	0.183	0.387	0.165	0.372	0.174	0.38
Household head is the father-in-law	0.791	0.407	0.753	0.432	0.762	0.427	0.775	0.418	0.78	0.415
Monthly household income < ₹2000 ($24)	0.48	0.5	0.46	0.499	0.443	0.497	0.48	0.5	0.487	0.501
Husband characteristics										
Husband's age	25.957	3.548	26.186	3.426	26.306	3.985	26.234	3.534	26.093	3.599
Husband's years of schooling completed	9.898	3.519	9.668	3.465	9.536	3.265	9.874	3.34	9.58	3.525
Husband's occupation:										
Daily wage worker	0.204	0.403	0.211	0.408	0.186	0.39	0.177	0.382	0.177	0.382
Agricultural worker	0.523	0.5	0.562	0.497	0.569	0.496	0.625	0.485	0.617	0.487
Migrant worker	0.118	0.323	0.072	0.259	0.086	0.281	0.069	0.254	0.067	0.25
Public sector employee	0.014	0.116	0.017	0.128	0.014	0.117	0.009	0.095	0.009	0.093
Private sector employee	0.095	0.293	0.089	0.285	0.097	0.296	0.072	0.259	0.058	0.234
Unemployed	0.034	0.181	0.028	0.164	0.017	0.128	0.033	0.179	0.046	0.211
Marriage characteristics										
Number of years married at baseline	3.688	3.175	3.657	3.416	3.586	3.14	3.58	3.165	3.461	2.981
Knew husband before marriage	0.293	0.456	0.23	0.421	0.205	0.404	0.195	0.397	0.243	0.43
Husband lives in the same household for at least 9 months in a year	0.973	0.163	0.97	0.172	0.981	0.138	0.967	0.179	0.954	0.211
Spend less than 6 hours alone with husband in a day	0.779	0.415	0.814	0.389	0.812	0.392	0.793	0.406	0.797	0.403
Husband spends less than 6 hours at home in a day	0.68	0.467	0.568	0.496	0.584	0.493	0.565	0.497	0.548	0.498
Husband discusses work often	0.505	0.501	0.548	0.498	0.515	0.5	0.544	0.499	0.594	0.492
Husband discusses community issues often	0.45	0.498	0.432	0.496	0.413	0.493	0.459	0.499	0.475	0.5
Husband discusses family issues often	0.552	0.498	0.568	0.496	0.551	0.498	0.58	0.494	0.6	0.491
Husband discusses family planning often	0.568	0.496	0.582	0.494	0.576	0.495	0.547	0.499	0.571	0.496

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Fertility history											
Been pregnant before	0.475	0.5	0.438	0.497	0.452	0.498	0.48	0.5	0.452	0.498	
Number of previous pregnancies	1.474	0.77	1.418	0.759	1.54	0.891	1.481	0.752	1.487	0.905	
Pregnancy ended in a live birth	0.453	0.498	0.429	0.496	0.446	0.498	0.465	0.5	0.435	0.496	
Pregnancy ended in a stillbirth	0.027	0.162	0.014	0.117	0.008	0.091	0.03	0.171	0.014	0.12	
Pregnancy ended in a miscarriage	0.002	0.047	0.006	0.074	0.003	0.053	0	0	0.006	0.076	
Pregnancy ended in an abortion	0.005	0.067	0.003	0.053	0	0	0.003	0.055	0	0	
Number of alive children	0.662	0.893	0.609	0.882	0.69	0.962	0.67	0.878	0.641	0.942	
Health-seeking during most recent live birth											
Number of antenatal care (ANC) visits completed	1.368	1.628	1.157	0.779	1.118	0.543	1.314	0.986	1.304	1.474	
Paid for ANC visit	0.421	0.495	0.472	0.501	0.417	0.495	0.392	0.49	0.396	0.491	
Current pregnancy											
Gestational age at baseline (in months)	4.773	1.1	4.593	1.099	4.571	1.136	4.517	1.243	4.545	1.257	
Pregnancy is registered with healthcare worker	0.939	0.239	0.895	0.307	0.936	0.245	0.928	0.259	0.922	0.269	
Receiveda Mother and Child Protection (MCP) Card	0.799	0.402	0.786	0.41	0.79	0.408	0.819	0.386	0.792	0.406	
Gone for any ANC visits	0.856	0.352	0.789	0.408	0.784	0.412	0.775	0.418	0.832	0.375	
Number of ANC visits compeleted at baseline	1.428	0.917	1.233	0.904	1.277	0.969	1.186	0.892	1.264	0.878	
ANC Knowledge Index											
Correctly identified ANC is important for detecting complications for the mother	0.734	0.442	0.659	0.475	0.668	0.472	0.724	0.448	0.707	0.456	
Correctly identified ANC is important for detecting complications for the fetus	0.775	0.418	0.668	0.472	0.676	0.469	0.685	0.465	0.713	0.453	
Correctly identified ANC is important for early intervention	0.588	0.493	0.593	0.492	0.618	0.487	0.556	0.498	0.568	0.496	
Correctly identified total number of ANC visits recommended	0.793	0.406	0.654	0.476	0.654	0.476	0.655	0.476	0.658	0.475	
Know about the Janani Shishu Suraksha (JSS) government benefit	0.791	0.407	0.659	0.475	0.679	0.468	0.7	0.459	0.719	0.45	
Know the date of the Village Health and Nutrition Day (VHND)	0.806	0.396	0.734	0.442	0.726	0.447	0.766	0.424	0.765	0.424	
Correctly identified riskier pregnancy in first described situation	0.705	0.457	0.726	0.447	0.742	0.438	0.745	0.437	0.667	0.472	
Correctly identified riskier pregnancy in second described situation	0.347	0.477	0.374	0.485	0.352	0.478	0.396	0.49	0.386	0.487	
Know the cost of an ANC visit	0.928	0.259	0.95	0.218	0.956	0.206	0.943	0.232	0.907	0.291	

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Iron and Folic Acid (IFA) Knowledge Index										
Correctly identified the use of IFA supplements for blood volume	0.908	0.29	0.859	0.349	0.884	0.321	0.928	0.259	0.916	0.278
Correctly identified the use of IFA supplements to treat anemia	0.471	0.5	0.443	0.497	0.427	0.495	0.505	0.501	0.519	0.5
Know the risk of untreated anemia	0.93	0.255	0.859	0.349	0.87	0.337	0.817	0.387	0.806	0.396
Know the importance of IFA supplementation	0.635	0.482	0.62	0.486	0.648	0.478	0.634	0.483	0.612	0.488
Permission needed from husband on the following:										
Buy clothing for yourself	0.822	0.383	0.837	0.37	0.861	0.346	0.862	0.346	0.843	0.364
Buy things in the market	0.84	0.367	0.845	0.363	0.864	0.343	0.868	0.339	0.843	0.364
Visit a family planning clinic	0.885	0.319	0.856	0.352	0.861	0.346	0.868	0.339	0.841	0.367
Meet the ASHA worker	0.854	0.354	0.848	0.36	0.861	0.346	0.886	0.318	0.872	0.334
Visit the home of friends by yourself	0.851	0.356	0.892	0.311	0.906	0.292	0.895	0.307	0.936	0.245
Travel a short distance by bus or train or other public transport	0.878	0.327	0.895	0.307	0.906	0.292	0.895	0.307	0.893	0.31
Visit your maternal home	0.903	0.296	0.909	0.289	0.925	0.263	0.898	0.303	0.907	0.291
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.91	0.287	0.903	0.296	0.914	0.281	0.889	0.315	0.907	0.291
Permission needed from the mother-in-law on the following:										
Buy clothing for yourself	0.815	0.388	0.834	0.373	0.85	0.357	0.85	0.358	0.838	0.369
Buy things in the market	0.838	0.369	0.837	0.37	0.861	0.346	0.847	0.361	0.832	0.375
Visit a family planning clinic	0.858	0.349	0.834	0.373	0.853	0.354	0.85	0.358	0.835	0.372
Meet the ASHA worker	0.838	0.369	0.839	0.368	0.853	0.354	0.871	0.336	0.858	0.35
Visit the home of friends by yourself	0.849	0.358	0.881	0.324	0.917	0.276	0.904	0.295	0.919	0.273
Travel a short distance by bus or train or other public transport	0.878	0.327	0.898	0.304	0.914	0.281	0.901	0.299	0.896	0.306
Visit your maternal home	0.896	0.305	0.895	0.307	0.925	0.263	0.898	0.303	0.899	0.302
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.91	0.287	0.898	0.304	0.92	0.272	0.898	0.303	0.901	0.298
Restrictive relationship with mother-in-law										
MIL limits contact with female friends	0.455	0.499	0.596	0.491	0.554	0.498	0.607	0.489	0.594	0.492
MIL limits contact with maternal household members	0.414	0.493	0.579	0.494	0.54	0.499	0.574	0.495	0.577	0.495
Cannot discuss issues relating to your health or women's health in general with MIL	0.225	0.418	0.141	0.349	0.166	0.373	0.15	0.358	0.165	0.372
MIL gets upset if you disagree with her on something	0.426	0.495	0.596	0.491	0.571	0.496	0.601	0.491	0.617	0.487
Feel nervous discussing issues or arguing with MIL	0.439	0.497	0.482	0.5	0.476	0.5	0.453	0.499	0.472	0.5

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Adherence to social norms											
A woman's most important role is to be a good homemaker	0.908	0.29	0.878	0.328	0.873	0.334	0.922	0.269	0.913	0.282	
It is not good for pregnant women to be seen alone in public	0.804	0.397	0.812	0.392	0.845	0.363	0.841	0.366	0.855	0.353	
A woman should tolerate violence to keep the family together	0.579	0.494	0.607	0.489	0.615	0.487	0.61	0.489	0.603	0.49	
A daughter-in-law should not argue with her mother-in-law	0.836	0.371	0.842	0.365	0.87	0.337	0.859	0.349	0.849	0.358	
A daughter-in-law should listen to her mother-in-law regarding maternal health issues	0.923	0.266	0.934	0.249	0.956	0.206	0.928	0.259	0.933	0.25	
Women should be able to travel on their own to health centers	0.09	0.287	0.158	0.365	0.175	0.38	0.093	0.291	0.125	0.331	

This table presents the means and standard deviations of daughters-in-law reported covariates in the control and treatment groups at baseline, prior to any intervention and post-randomization. For binary characteristics, it shows the proportion of daughters-in-law.

Table B.7: Baseline covariate balance of endline sample (DIL responses only) (N=1,844)

	Pairwise differences *p*-values							
	Control vs. T1	Control vs. T2	Control vs.T3	Control vs.T4	T1 vs.T2	T3 vs. T4	T1 vs. T3	T2 vs.T4
Daughter-in-law characteristics								
Age at baseline	0.154	0.507	0.695	0.936	0.84	0.896	0.307	0.635
Years of schooling completed	0.515	0.499	0.28	0.967	0.549	0.298	0.337	0.978
Religion: Hindu	0.524	0.007 ***	0.098 *	0.052 *	0.289	0.554	0.641	0.983
Social category: General	0.393	0.423	0.668	0.506	0.788	0.564	0.742	0.52
Social category: Scheduled caste/ Scheduled tribe	0.021 **	0.601	0.447	0.898	0.039 **	0.479	0.329	0.105
Social category: Other backward castes	0.023 **	0.645	0.431	0.682	0.02 **	0.78	0.24	0.19
Currently working outside the home	0.485	0.216	0.063 *	0.374	0.749	0.596	0.113	0.25
Household characteristics								
Total permanent household members	0.648	0.7	0.506	0.625	0.484	0.559	0.583	0.574
Household head is the mother-in-law	0.992	0.429	0.593	0.663	0.681	0.885	0.93	0.404
Household head is the father-in-law	0.381	0.242	0.328	0.382	0.962	0.521	0.919	0.324
Monthly household income < ₹2000 ($24)	0.768	0.439	0.582	0.495	0.668	0.155	0.517	0.931
Husband characteristics								
Husband's age	0.886	0.786	0.611	0.509	0.649	0.891	0.887	0.803
Husband's years of schooling completed	0.169	0.101	0.328	0.54	0.646	0.324	0.218	0.408
Husband's occupation:								
Daily wage worker	0.245	0.662	0.672	0.593	0.313	0.856	0.756	0.867
Agricultural worker	0.689	0.785	0.133	0.013 **	0.996	0.913	0.717	0.427
Migrant worker	0.077 *	0.651	0.185	0.026 **	0.339	0.796	0.808	0.619
Public sector employee	0.666	0.797	0.761	0.666	0.882	0.837	0.564	0.477
Private sector employee	0.772	0.92	0.403	0.105	0.675	0.348	0.733	0.039 **
Unemployed	0.139	0.101	0.395	0.492	0.512	0.621	0.746	0.037 **
Marriage characteristics								
Number of years married at baseline	0.312	0.998	0.048 **	0.375	0.64	0.895	0.17	0.23
Knew husband before marriage	0.012 **	0.019 **	0.104	0.562	0.802	0.187	0.189	0.056 *
Husband lives in the same household for at least 9 months in a year	0.455	0.11	0.775	0.731	0.11	0.514	0.829	0.025 **
Spend less than 6 hours alone with husband in a day	0.847	0.888	0.371	0.329	0.878	0.534	0.794	0.936
Husband spends less than 6 hours at home in a day	0.355	0.482	0.167	0.089 *	0.059 *	0.531	0.967	0.419
Husband discusses work often	0.158	0.351	0.136	0.03 **	0.287	0.154	0.794	0.297
Husband discusses community issues often	0.445	0.467	0.136	0.034 **	0.923	0.852	0.911	0.455
Husband discusses family issues often	0.345	0.336	0.025 **	0.041 **	0.549	0.933	0.74	0.341
Husband discusses family planning often	0.182	0.15	0.178	0.048 **	0.878	0.608	0.352	0.627

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Fertility history									
Been pregnant before	0.484	0.375	0.933	0.407	0.484	0.327	0.835	0.963	
Number of previous pregnancies	0.405	0.108	0.981	0.88	0.202	0.911	0.888	0.355	
Pregnancy ended in a live birth	0.084 *	0.175	0.311	0.753	0.631	0.716	0.732	0.05 *	
Pregnancy ended in a stillbirth	0.847	0.06 *	0.616	0.235	0.337	0.137	0.45	0.404	
Pregnancy ended in a miscarriage	0.29	0.393	0.902	0.825	0.573	0.165	0.159	0.222	
Pregnancy ended in an abortion	0.606	0.276	0.801	0.716	0.34	0.338	0.925	.	
Number of alive children	0.391	0.064 *	0.765	0.813	0.156	0.743	0.59	0.047 **	
Health-seeking during most recent live birth									
Number of antenatal care (ANC) visits completed	0.273	0.224	0.567	0.689	0.99	0.719	0.38	0.319	
Paid for ANC visit	0.394	0.719	0.495	0.488	0.101	0.752	0.133	0.708	
Current pregnancy									
Gestational age at baseline (in months)	0.49	0.363	0.896	0.339	0.75	0.741	0.886	0.734	
Pregnancy is registered with healthcare worker	0.154	0.888	0.894	0.714	0.013 **	0.572	0.012 **	0.649	
Receiveda Mother and Child Protection (MCP) Card	0.149	0.097 *	0.364	0.071 *	0.911	0.152	0.486	0.992	
Gone for any ANC visits	0.132	0.238	0.104	0.556	0.876	0.026 **	0.677	0.104	
Number of ANC visits compeleted at baseline	0.299	0.63	0.089 *	0.797	0.413	0.261	0.89	0.966	
ANC Knowledge Index									
Correctly identified ANC is important for detecting complications for the mother	0.978	0.764	0.988	0.895	0.513	0.569	0.192	0.912	
Correctly identified ANC is important for detecting complications for the fetus	0.203	0.327	0.125	0.677	0.614	0.341	0.589	0.457	
Correctly identified ANC is important for early intervention	0.6	0.45	0.281	0.208	0.072 *	0.869	0.676	0.784	
Correctly identified total number of ANC visits recommended	0.02 **	0.011 **	0.003 ***	0.011 **	0.62	0.834	0.889	0.708	
Know about the Janani Shishu Suraksha (JSS) government benefit	0.041 **	0.09 *	0.094 *	0.035 **	0.116	0.128	0.589	0.435	
Know the date of the Village Health and Nutrition Day (VHND)	0.181	0.12	0.271	0.097 *	0.967	0.991	0.297	0.476	
Correctly identified riskier pregnancy in first described situation	0.463	0.232	0.528	0.122	0.659	0.015 **	0.493	0.929	
Correctly identified riskier pregnancy in second described situation	0.62	0.858	0.965	0.395	0.657	0.461	0.656	0.94	
Know the cost of an ANC visit	0.245	0.202	0.356	0.886	0.944	0.027 **	0.812	0.153	

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Iron and Folic Acid (IFA) Knowledge Index										
Correctly identified the use of IFA supplements for blood volume	0.232	0.635	0.562	0.193	0.218	0.476	0.052 *	0.378		
Correctly identified the use of IFA supplements to treat anemia	0.507	0.459	0.977	0.375	0.892	0.767	0.234	0.062 *		
Know the risk of untreated anemia	0.557	0.435	0.079 *	0.13	0.705	0.406	0.655	0.231		
Know the importance of IFA supplementation	0.374	0.191	0.017 **	0.153	0.924	0.876	0.83	0.76		
Permission needed from husband on the following:										
Buy clothing for yourself	0.627	0.868	0.679	0.353	0.855	0.959	0.715	0.246		
Buy things in the market	0.341	0.437	0.616	0.099 *	0.875	0.572	0.681	0.265		
Visit a family planning clinic	0.076 *	0.045 **	0.133	0.016 **	0.413	0.765	0.328	0.236		
Meet the ASHA worker	0.226	0.14	0.759	0.601	0.704	0.746	0.987	0.942		
Visit the home of friends by yourself	0.794	0.652	0.656	0.072 *	0.991	0.003 ***	0.243	0.1		
Travel a short distance by bus or train or other public transport	0.914	0.773	0.672	0.31	0.925	0.389	0.275	0.806		
Visit your maternal home	0.758	0.849	0.297	0.977	0.599	0.215	0.117	0.345		
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.749	0.722	0.2	0.58	0.907	0.016 **	0.095 *	0.926		
Permission needed from the mother-in-law on the following:										
Buy clothing for yourself	0.683	0.434	0.436	0.127	0.613	0.567	0.518	0.285		
Buy things in the market	0.245	0.383	0.147	0.052 *	0.886	0.935	0.329	0.228		
Visit a family planning clinic	0.328	0.345	0.138	0.298	0.822	0.491	0.469	0.478		
Meet the ASHA worker	0.483	0.219	0.271	0.19	0.689	0.57	0.671	0.784		
Visit the home of friends by yourself	0.941	0.2	0.485	0.228	0.102	0.219	0.943	0.809		
Travel a short distance by bus or train or other public transport	0.815	0.413	0.369	0.042 **	0.632	0.498	0.541	0.639		
Visit your maternal home	0.3	0.783	0.271	0.885	0.157	0.217	0.348	0.193		
Is your opinion taken into account when purchasing an expensive item like a bicycle or cow	0.533	0.815	0.396	0.92	0.327	0.214	0.299	0.667		
Restrictive relationship with mother-in-law										
MIL limits contact with female friends	0.652	0.105	0.745	0.751	0.252	0.945	0.553	0.076 *		
MIL limits contact with maternal household members	0.893	0.346	0.67	0.284	0.232	0.478	0.971	0.146		
Cannot discuss issues relating to your health or women's health in general with MIL	0.852	0.763	0.36	0.281	0.525	0.452	0.765	0.974		
MIL gets upset if you disagree with her on something	0.474	0.606	0.202	0.018 **	0.292	0.843	0.58	0.347		
Feel nervous discussing issues or arguing with MIL	0.743	0.291	0.52	0.523	0.747	0.847	0.832	0.68		

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Adherence to social norms								
A woman's most important role is to be a good homemaker	0.974	0.908	0.946	0.487	0.656	0.627	0.713	0.626
It is not good for pregnant women to be seen alone in public	0.91	0.301	0.695	0.871	0.215	0.679	0.751	0.98
A woman should tolerate violence to keep the family together	0.523	0.743	0.537	0.488	0.454	0.387	0.23	0.843
A daughter-in-law should not argue with her mother-in-law	0.672	0.432	0.431	0.878	0.723	0.96	0.397	0.308
A daughter-in-law should listen to her mother-in-law regarding maternal health issues	0.658	0.742	0.342	0.844	0.303	0.274	0.321	0.12
Women should be able to travel on their own to health centers	0.152	0.109	0.971	0.87	0.219	0.198	0.633	0.556

The table includes two types of pairwise comparisons: the first set of p-values indicates significant differences between the control group and each treatment group, and the second set compares the treatment groups of interest for the analysis. The displayed p-values result from a regression of the dependent variable on an indicator variable for each treatment group, with the control vs. treatment groups and an indicator variable using the first treatment group specified as the reference category. Strata fixed effects are included, and standard errors are clustered at the village level (not shown here). * denotes statistical significance at 10 pct, ** at 5 pct, and *** at 1 pct level.

Table B.8: Attrition between baseline and midline by treatment arms

	Daughters-in-law (DILs)		Mothers-in-law (MILs)	
	(1)	(2)	(1)	(2)
	Without covariates	With covariates	Without covariates	With covariates
Panel A. Pooled treatments				
Group	-0.055	-0.080 **	-0.041	-0.066 *
	(0.033)	(0.035)	(0.034)	(0.035)
	0.100	0.021	0.231	0.056
Individual	-0.047	-0.064 *	-0.032	-0.049
	(0.036)	(0.038)	(0.035)	(0.037)
	0.193	0.097	0.372	0.190
Control mean	0.205	0.205	0.215	0.215
Observations	2,367	2,189	2,367	2,189
R-squared	0.153	0.180	0.125	0.159
p (Group=Individual)	0.763	0.572	0.738	0.573
Panel B. All treatments				
T1: Individual + Only DIL	-0.069*	-0.080 **	-0.053	-0.066 *
	(0.036)	(0.038)	(0.037)	(0.038)
	0.092	0.037	0.149	0.088
T2: Individual + DIL&MIL	-0.023	-0.038	-0.009	-0.026
	(0.038)	(0.038)	(0.040)	(0.041)
	0.536	0.319	0.825	0.527
T3: Group + Only DIL	-0.060*	-0.075 **	-0.034	-0.045
	(0.036)	(0.036)	(0.040)	(0.040)
	(0.036)	0.036	0.401	0.256
T4: Group + DIL&ML	-0.049	-0.063 *	-0.048	-0.065 *
	(0.035)	(0.035)	(0.036)	(0.037)
	0.155	0.072	0.185	0.079
Control mean	0.205	0.205	0.215	0.215
Observations	2,367	2,189	2,367	2,189
R-squared	0.155	0.202	0.126	0.178
p (T1=T2)	0.621	0.612	0.672	0.568
p (T3=T4)	0.0162	0.0397	0.143	0.199
p (T1=T3)	0.780	0.884	0.602	0.576
p (T2=T4)	0.414	0.418	0.286	0.295

Notes: This table displays the attrition rates of both daughters-in-law and mothers-in-law between baseline and midline. The attrition variable is an indicator that equals 0 if the baseline survey respondent has a corresponding midline survey and 1 if they do not have a midline survey (have attrited from the study). Panel A shows differential attrition for the pooled treatment groups, where the treatment variable is 1 if the participants belong to the group (individual) treatment and 0 if they belong to the control group. Panel B shows the differential attrition for all four treatments, where the treatment variable is 1 if the participants belong to T1-T4 and 0 if they belong to the control group. Each row and column represent a separate regression. Both models (1) and (2) include strata fixed effects, and standard errors clustered at the village level are shown in parentheses. Model (2) includes all baseline covariates specified in Table B.2. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table B.9: Attrition between baseline and endline by treatment arms

	Daughters-in-law (DILs)		Mothers-in-law (MILs)	
	(1)	(2)	(1)	(2)
	Without controls	**With controls**	**Without controls**	**With controls**
Panel A. Pooled treatments				
Group	0.024	0.012	0.018	0.011
	(0.031)	(0.031)	(0.030)	(0.031)
	0.429	0.709	0.566	0.715
Individual	0.023	0.023	0.014	0.015
	(0.030)	(0.031)	(0.031)	(0.031)
	0.443	0.453	0.660	0.629
Control mean	0.138	0.138	0.152	0.152
Observations	2,367	2,189	2,367	2,189
R-squared	0.128	0.129	0.114	0.129
p (Group=Individual)	0.966	0.684	0.887	0.894
Panel B. All treatments				
T1: Individual + Only DIL	0.027	0.038	0.022	0.033
	(0.032)	(0.031)	(0.034)	(0.031)
	0.402	0.219	0.510	0.290
T2: Individual + DIL&MIL	0.019	0.021	0.004	0.010
	(0.031)	(0.031)	(0.032)	(0.032)
	0.551	0.491	0.890	0.749
T3: Group + Only DIL	0.028	0.035	0.022	0.033
	(0.031)	(0.030)	(0.031)	(0.030)
	0.368	0.252	0.476	0.283
T4: Group + DIL&ML	0.020	0.024	0.013	0.023
	(0.033)	(0.033)	(0.033)	(0.033)
	0.539	0.469	0.703	0.494
Control mean	0.138	0.138	0.152	0.152
Observations	2,367	2,189	2,367	2,189
R-squared	0.128	0.175	0.114	0.166
p (T1=T2)	0.682	0.602	0.634	0.647
p (T3=T4)	0.691	0.468	0.442	0.339
p (T1=T3)	0.969	0.909	0.992	0.984
p (T2=T4)	0.962	0.940	0.800	0.707

Notes: This table displays the attrition rates of both daughters-in-law and mothers-in-law between baseline and endline. The attrition variable is an indicator that equals 0 if the baseline survey respondent has a corresponding endline survey and 1 if they do not have a endline survey (have attrited from the study) Panel A shows differential attrition for the pooled treatment groups, where the treatment variable is 1 if the participants belong to the group (individual) treatment and 0 if they belong to the control group. Panel B shows the differential attrition for all four treatments, where the treatment variable is 1 if the participants belong to T1-T4 and 0 if they belong to the control group. Each row and column represent a separate regression. Both models (1) and (2) include strata fixed effects, and standard errors clustered at the village level are shown in parentheses. Model (2) includes all baseline covariates specified in Table B.2. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

B.2 Maternal health training scripts

B.2.1 Maternal health script for only pregnant women

Namaste, my name is XXX and I am working on behalf of Noora Health, an NGO working with local hospitals to help women get the right care during pregnancy. As you may remember, a member of our team met you recently.
Can you confirm that you are ¡read out name of respondent¿? Now can you please confirm how far along in the pregnancy you are? months / weeks pregnant?
Today, we would like to provide you with some important information regarding your health during pregnancy. This will take about 15 minutes of your time.
Pregnancy can be a confusing time and there are things you need to do to take care of yourself and your baby. Have you visited the hospital/clinic for ANC check-ups?

- Yes: Very good. Now we will give you more information about this.
- No: Let us go ahead and learn about ANC, and why it is important.

1. **Antenatal care visits**: During pregnancy, it is important to monitor your health in order to detect any health complications and provide treatment. Some pregnant women may undergo problems such as high blood pressure, high blood sugar level, anemia or breech of position of baby. Often, we don't realize these problems are happening. ANC visits help to detect these problems that would have otherwise not been detected and thus protect your health as well as the health of your baby.

   It is important to go for at least 4 ANC visits throughout your pregnancy to make sure your baby is growing healthy. Going for an ANC visit means going to a medical provider like a doctor or the ANM. If the ASHA comes to your home and advises you, it is good for you but that is not an ANC visit as no tests or check ups are performed.

   - Go for at least 1 ANC visit as soon as you know you are pregnant. This is especially important because this is the time to register your pregnancy and get your Mother-Child Protection (MCP) card.
   - The MCP card has many advantages: It allows you and your family to track your pregnancy and keep your records in one place so you have it when you go to deliver.
   - You cannot avail any benefits of government schemes without the MCP card. With the card, you and your baby would be eligible for free delivery, cash assistance, antenatal and postnatal care and many other benefits described in detail on the back of the card.
   - Remember, you can only register the pregnancy and get the MCP card through the ANM.
   - You must go for a total of at least 4 ANC visits throughout your pregnancy.

- ANC visits are provided for free at the Village Health and Nutrition Day (VHND) held at your village every month or for free at your ANM's clinic. You can also get it done on the 9th of every month through the PMMSY.
- You can also go to the district hospital or any clinic at any time to get a check-up done during the pregnancy.
- It is important to remember the Madhya Pradesh (MP) rule: If you go to the hospital for the last two ANC visits, then you can get your MCP number registered with the hospital and get a maximum of Rs. 1400 from the Janani Suraksha Yojana (JSY) scheme when you deliver at the same hospital. Call the 108 number to get a bus to reach the hospital. It is free of cost for women in your situation.

Sometimes it may happen that you are alone at home because your husband has gone for work, and your mother-in-law or other family members are also not at home. And you may be expected to manage the house on your own, at the expense of going to the hospital for a check-up or taking adequate rest. Or you may hear your family members like your mother-in-law or husband asking you not to waste time with these check ups, and stay at home to complete house work. But by not going for the check-ups you risk the chance of harming yourself and your baby. Talk to your MIL and ask her to let you go or to take you herself for the check up.

Do you want me to repeat any of the information I shared about the ANC visit?

2. **Iron folic acid tablets**: Do you know what IFA tablets are?

   Most women are not able to get all the nutrition needed to grow another life. Anemia is one of the most common conditions in pregnancy that can lead to poor health and even death in pregnant women. Your anemia can affect the baby's growth and health. Fortunately, this can be easily controlled through iron and folic acid tablets.

   - Take one tablet of iron and folic acid a day throughout your pregnancy. These will be provided to you for free during your ANC visit. If you miss a dose, it's okay. Take one on the next day.
   - IFA tablets may make you nauseous, make your stools black, or give you an upset stomach. Do not be discouraged. They will ensure your baby doesn't have any birth defects and you don't get anemic. Drink lots of water throughout the day and eat a diet rich in dark leafy vegetables.
   - These are the key things you need to do once you find out you are pregnant. If you do, your baby will grow healthy without any problems.

Lastly, we would like to talk to you about a part of pregnancy that often gets overlooked. At this time, you must be feeling excited, nervous, tired and some physical discomfort.

We advise pregnant women to ask their family for help and support. Your mother-in-law and husband are the people you should rely on during this time. Here are some ways in which you can do this:

- It can be difficult to go for ANC visits alone. Ask your mother-in-law to accompany you to the clinic. We understand that it is sometimes difficult to talk about subjects related to pregnancy and childbirth openly with your family. However, talking to your mother-in-law about the importance of ANC visits like we discussed above, as well as the risks involved if you do not get your health checked regularly will help keep both you and your baby healthy. If your mother-in-law or husband are busy, you can also request a friend of yours to accompany you for an ANC check-up.
- Pregnancy can be tiring especially in the first and last trimester. Try to sleep or rest during the day for an hour at least. Ask your mother-in-law to help with household chores so you can get some time to sleep.
- Many women in your family or among your friends might have already had children. You will receive advice from all these people who care about you on how to take care of your health, what food you should eat, how often you should visit the doctor, etc. In these situations, it is important to remember to always consult your doctor or your ASHA or ANM, and listen to their advice first.

Remember, you are growing a life in you and it is important you prioritize yourself and your baby. That should matter the most to you and your family.

B.2.2 Maternal health script for pregnant women and mothers-in-law

Namaste, my name is XXX and I am working on behalf of Noora Health, an NGO working with local hospitals to help women get the right care during pregnancy. As you may remember, a member of our team met you recently.
Can you confirm that you are ¡read out name of respondent¿? Now Can you please confirm how far along in the pregnancy you are? months / weeks pregnant?
Today, we would like to provide you with some important information regarding your health during pregnancy. This will take about 15 minutes of your time.
Pregnancy can be a confusing time and there are things you need to do to take care of yourself and your baby.
@MIL: Maybe you already know many of the things we might be telling you today. But it is possible that there are better ways to take care of your daughter-in-law's health during pregnancy that might not have existed during your time. That is why we want to talk with both of you together.
@DIL: Have you visited the hospital/clinic for ANC check-ups?

- Yes: Very good. Now we will give you more information about this.
- No: Let us go ahead and learn about ANC, and why it is important.

1. **Antenatal care visits**: During pregnancy, it is important to monitor your health in order to detect any health complications and provide treatment. Some pregnant women may undergo problems such as high blood pressure, high blood sugar level, anemia or breech of position of baby. Often, we don't realize these problems are happening. ANC visits help to detect these problems that would have otherwise not been detected and thus protect your health as well as the health of your baby.

   It is important to go for at least 4 ANC visits throughout your pregnancy to make sure your baby is growing healthy. Going for an ANC visit means going to a medical provider like a doctor or the ANM. If the ASHA comes to your home and advises you, it is good for you but that is not an ANC visit as no tests or check ups are performed.

   - Go for at least 1 ANC visit as soon as you know you are pregnant. This is especially important because this is the time to register your pregnancy and get your Mother-Child Protection (MCP) card.
   - The MCP card has many advantages: It allows you and your family to track your pregnancy and keep your records in one place so you have it when you go to deliver.
   - You cannot avail any benefits of government schemes without the MCP card. With the card, you and your baby would be eligible for free delivery, cash assistance, antenatal and postnatal care and many other benefits described in detail on the back of the card.
   - Remember, you can only register the pregnancy and get the MCP card through the ANM.
   - You must go for a total of at least 4 ANC visits throughout your pregnancy.
   - ANC visits are provided for free at the Village Health and Nutrition Day (VHND) held at your village every month or for free at your ANM's clinic. You can also get it done on the 9th of every month through the PMMSY.
   - You can also go to the district hospital or any clinic at any time to get a check-up done during the pregnancy.
   - It is important to remember the Madhya Pradesh (MP) rule: If you go to the hospital for the last two ANC visits, then you can get your MCP number registered with the hospital and get a maximum of Rs. 1400 from the Janani Suraksha Yojana (JSY) scheme when you deliver at the same hospital. Call the 108 number to get a bus to reach the hospital. It is free of cost for women in your situation.

@DIL: Sometimes it may happen that you are alone at home because your husband has gone for work, and your mother-in-law or other family members are also not at home.

@MIL: Sometimes, your daughter-in-law may be expected to manage the house on her own and complete house work, instead of going to the hospital for a check-up or taking adequate rest.

But by not going for the check-ups you risk the chance of harming yourself and your baby. Talk to each other about when you would like to visit the doctor for a check up, so that you can either go together to the hospital or you can find someone to go with you.

Do you want me to repeat any of the information I shared about the ANC visit?

2. **Iron folic acid tablets**: Do you know what IFA tablets are?

   Most women are not able to get all the nutrition needed to grow another life. Anemia is one of the most common conditions in pregnancy that can lead to poor health and even death in pregnant women. Your anemia can affect the baby's growth and health. Fortunately, this can be easily controlled through iron and folic acid tablets.

   - Take one tablet of iron and folic acid a day throughout your pregnancy. These will be provided to you for free during your ANC visit. If you miss a dose, it's okay. Take one on the next day.
   - IFA tablets may make you nauseous, make your stools black, or give you an upset stomach. Do not be discouraged. They will ensure your baby doesn't have any birth defects and you don't get anemic. Drink lots of water throughout the day and eat a diet rich in dark leafy vegetables.
   - These are the key things you need to do once you find out you are pregnant. If you do, your baby will grow healthy without any problems.

Lastly, we would like to talk to you about a part of pregnancy that often gets overlooked. At this time, you must be feeling excited, nervous, tired and some physical discomfort. We advise pregnant women to ask their family for help and support. @DIL: Your mother-in-law and husband are the people you should rely on during this time. @MIL: Your daughter-in-law usually relies on you for help and advice during this time. Thus, it is important that you support her and give her good advice.

- It can be difficult to go for ANC visits alone. @DIL: Ask your mother-in-law to accompany you to the clinic. @MIL: Try to accompany your daughter-in-law to the ANC visit. We understand that it is sometimes difficult to talk about subjects related to pregnancy and childbirth openly with your family. However, talking to each other about the importance of ANC visits like we discussed above, as well as the risks involved if you do not get your health checked regularly will help keep both you

and your baby healthy. @DIL: If your mother-in-law or husband are busy, you can also request a friend of yours to accompany you for an ANC check-up.

- Pregnancy can be tiring especially in the first and last trimester. Try to sleep or rest during the day for an hour at least. @MIL: You can help your daughter-in-law with household chores so she can get some time to sleep.
- Many women in your family or among your friends might have already had children. You will receive advice from all these people who care about you on how to take care of your health, what food you should eat, how often you should visit the doctor, etc. @MIL: You might also have some advice based on your experience during your pregnancy. In these situations, it is important to remember to always consult your doctor or your ASHA or ANM, and listen to their advice first. @MIL: You will also receive advice from many of your friends on how to help your daughter-in-law be healthy during this time. It is normal to not have answers to all of your daughter-in-law's questions, and. It is also normal to not know everything about good health practices during pregnancy. In this case, always remember to consult a doctor or ask your daughter-in-law to consult a doctor.

Remember, you are growing a life in you and it is important you prioritize yourself and your baby. That should matter the most to you and your family.

Appendix C

Chapter 4 – Supplementary Tables and Figures

Table C.1: Mobile Care Companion Program (MCCP) messages and delivery schedule

Topic	Message	Schedule
Welcome	*Welcome 👋to Aarogya Seva! Congratulations 👏on your delivery!* 🤱 Taking care of a newborn can be hard. By sending messages about baby and mother care, we will make this easy for you.	Day 1, upon enrollment
Service information message	Todays message for your family : The Care Companion Program is here to support you on this journey. From today onwards, for the next 45 days, you will receive health messages regarding mother and child health at 8 am in the morning.	Day 1, upon enrollment
Breastfeeding initiation / colostrum	The Care Companion Program is here to support you on this journey. Make sure that the mother starts breastfeeding the baby within 1 hour of delivery. ✅ The first yellow milk produced is very good for your baby. This will build the baby's immunity and protect your baby against several diseases! 🚫Do not give honey, sugar water, gripe water, cow's milk or any animal milk as this can diarrhoea and even malnutrition. Breastfeed the baby whenever it demands or at least every 2- 3 hours, even during the night time.	Day 1, upon enrollment
Breastfeeding and flow of breast milk	Todays message for your family 👉: The Care Companion Program is here to support you on this journey. The amount of milk the mother is getting (producing), is adequate for her baby ! Dont worry ! Milk flow increases more and more as the baby sucks. The more you breastfeed the baby, the milk in your breasts will increase. Also, remember that your baby has a small stomach and the breastmilk you get is just the amount that the baby's stomach can hold at one time. Ensure that the mother is eating a nutritious diet 🌾🍛 and is drinking 8-10 glasses of water. 💧 💡 Remember, there are no restrictions in the diet. So, eat every type of food and dont eat less.	Day 2, 8 am
Burping	Todays message for your family 👉: The Care Companion Program is here to support you on this journey. 🤱🏾 Small babies throw up milk (regurgitate) quite often or vomit after feeds 🤮. To avoid this, remember to burp your baby after every feed. This is how you can do it *1.* Hold the baby over your shoulder *2.* Take care that the head of the baby is turned outward and the baby can breathe properly *3.* Pat over the baby's back gently or rub the back *4.* Keep like this position for 10 to 15 min or till the baby burps !👶🏾 VIDEO LINK: https://youtu.be/fJj9B6uHjyc	Day 3, 8 am

(continued on next page.)

Maternal support	Todays message for your family 👉:The Care Companion Program is here to support you on this journey. 🤱 The period of childbirth and recovery can be physically and mentally tiring for the mother. She needs a lot of rest 🛌. She needs the support for the family. Support her and give her time to rest, by doing important things for the baby like burping the baby, doing skin to skin care, and cleaning the baby. This can be done by the father, grandmother or any family member. Make sure to wash your hands before touching the baby 💦🧼 If you like this message, give thumbs up👍	Day 3, 8 am
Cord Infection	Todays message for your family 👉: - Keep the baby's cord clean and dry! 🚫Don't touch your baby's cord, don't try to pull it off and most importantly, do not apply ANYTHING on the cord such as powder, oil, cream, ghee or turmeric! 🚫 If the skin around the cord is red, there is swelling around the cord, pus, foul smell, or blood, or your baby cries on touching near the cord, take the baby to the hospital immediately.🏥 VIDEO LINK: https://youtu.be/Lov-p6e_798	Day 4, 8 am
Service information	Do you know that you can respond to our messages any time? And you can also ask us any questions that you may have about the mother or the baby? From Monday 8 am to Saturday 8 pm our nurses are here to answer all your questions and support you.	Day 5, 8 am
Baby sleep	Todays message for your family 👉: The Care Companion Program is here to support you on this journey.🙏 Your baby can sleep for more than 12 hours in a day. This may be in small durations, several times a day. Gently wake the baby and feed every 2-3 hours . 🕗 Even if you are unwell or have fever, you can breastfeed the baby. If the baby has fever, diarrhoea or is sick, the baby can be given breastfeeds. So, continue breastfeeding without any hesitation! 🤱	Day 6, 8 am
Skin-to-skin	Todays message for your family 👉: Providing warmth to the baby by placing the baby without clothes, on the bare chest of the mother, father or any family member, is skin to skin care or KMC 🤱. -This is an easy and very effective method to take care of babies below 2.5 kg weight, premature babies and sick babies. It is useful for normal babies as well. - It keeps the baby warm and helps gain weight. -It also helps the baby to grow well, improves its intelligence, and increases the family bonding. Skin to skin care can be done anytime in the day - each time for 1 hour or more, and as many times possible in a day. - 🕗 VIDEO LINK: https://youtu.be/Ln9xhliNy4k	Day 8, 8 am

(continued on next page.)

Hypothermia	Todays message for your family 👉: The Care Companion Program is here to support you on this journey.🙏🏾 Baby should be covered properly and kept warm in all weather conditions. Its head and feet should always be kept covered. -To prevent your baby from getting very cold, after cleaning the baby, use a towel to dry the baby. To find out if the baby is warm enough, check like this - -If the palms and soles of the baby feel cold, the baby has mild coldness of the body. Do skin to skin care. -If the chest and abdomen of the baby feel cold, it indicates severe coldness of the body.❄️ Place your baby, without clothes on your chest, cover both with a shawl and rush to the hospital immediately.🏥	Day 10, 8 am
Jaundice	Todays message for your family 👉: The Care Companion Program is here to support you on this journey.🙏🏾 Jaundice is common in newborns, and goes away by itself. In a few cases, it can become severe, which is harmful for the baby, causing deafness or brain damage. Jaundice starts from the face and spreads to the whole body. Detect it as early as possible rather than wait for it to spread. To recognise jaundice early, see if the face and eyes of the baby are yellow. Also, press the tip of the nose for a few seconds. If the skin looks yellow on removing the finger, the baby has mild jaundice. Continue to breastfeed your baby and take the baby to the doctor for a check up. If the baby's palms and soles are also yellow, the baby has severe jaundice. Do not delay. Take the baby to the hospital as soon as possible.🏥 If you like this message, give thumbs up👍 VIDEO LINK: https://youtu.be/CBao41yBE3U	Day 12, 8 am
Baby warning signs -1	The Care Companion Program is here to support you on this journey.🙏🏾 If your baby is having breathing difficulty, rapid breathing, ribs are prominent and chest goes in while breathing, making grunting sounds or has blueness of lips, palms, or soles - your baby has respiratory problems. Go to a doctor immediately. 🏥 VIDEO LINK: https://youtu.be/K6ggKM-VUbs	Day 14, 8 am

(continued on next page.)

Service info	The Care Companion Program is here to support you on this journey. Please message us on this chat if you have any questions about the baby or mother's health.	Day 16, 8 am
Diarrhoea	Todays message for your family 👉: Diarrhoea can be prevented by feeding only breast milk to the baby and maintaining cleanliness at all times! Feeding the baby anything other than breastmilk such as animal milk, water, gripe water etc, can cause diarrhoea. 🚫 Don't ignore diarrhea in a baby - it can quickly become dangerous.🚫 If the baby has loose motions, continue to breastfeed the baby more frequently. 🤱 Along with loose motions, if the baby is lethargic, restless, has dry mouth or is passing urine 4 times or less in a day, the condition is severe. Rush to the hospital at the earliest! 🏥 Delays can be dangerous for the baby's life.	Day 18, 8 am
Maternal diet	Todays message for your family 👉: There must be no restrictions in the food for the mother. A lactating mother requires a nutritious and complete diet after the delivery. This will help in wound healing for the mother, help increase the breast milk, and help in the baby's growth. She should have locally available fruits and vegetables. Her food should include grains like rice and wheat, green leafy vegetables (spinach), drumstick leaves, pulses (dal), rajma, groundnuts, jaggery, dates, paneer, milk and if non - vegetarian, she can eat eggs, meat or fish. 🍛🥕🥦🍗🍎🥭🍎🥛 She must also drink 8 -10 glasses of water everyday. 💧 Use iodized salt in the food.💪 She should take 1 tablet of Iron and Calcium daily for 6 months 💪 VIDEO LINK: https://youtu.be/rxtSd2uIWrc	Day 20, 8 am
Mother warning signs	Todays message for your family 👉: Caring for the mother after delivery is as important as caring for the baby * ❤️👶 ⚠️ if mother has excessive vaginal bleeding , burning sensation while passing urine, or fever ⚠️ pain or redness around the stitches, pus discharge, or the wound has opened up ⚠️ breast problems like redness, pain, lumps, crack/tear in the nipple ⚠️ or dizziness, fits, excessive tiredness, or loss of appetite Make sure to visit the hospital immediately! 🏥	Day 22, 8 am
Baby warning signs-2	Todays message for your family 👉: If you see these warning signs ⚠️ in the baby, take the baby to the hospital immediately 🏥 ⚠️ Breathing difficulty or rapid breathing ⚠️ Passing urine less than 4 times in a day, loose motions many times in a day or blood in stools ⚠️ Pus discharge from the cord or redness around it ~ ⚠️ Skin infection with 10 or more small pustules or 1 large boil ⚠️ Jaundice , Fever, coldness of the baby's body, Lethargy or inactive baby, fits If you see any of these signs, take your baby to the hospital ! 🏥Do not delay ! VIDEO LINK: https://youtu.be/oA8suyA2LaQ	Day 24, 8 am

Family Planning	Todays message for your family 👉: A woman can become pregnant even when she is breastfeeding, even within 2 months of delivery, if she does not use any family planning method. Select and start using any type of contraceptive method to avoid pregnancy, like condoms, Copper T, oral tablets or operation. Please contact the ASHA or ANM in your area and ask about them. Keeping a gap of at least 3 years 🗓️ helps in improving the health of the baby and the mother, and it helps in the family savings too 👨‍👩‍👧‍👦 ❗ Having children with a short gap between their births, leads to increased risk of disease or death in the mother or the child. ❗	Day 26, 8 am
Immunization	Todays message for your family 👉: The baby must be immunized right from birth onwards, against serious childhood infections like Polio, T.B, Measles, Diphtheria, Pertussis and Hepatitis and many more. 💉 Vaccines are given according to the schedule provided in the Mother and Child Protection (MCP) Card. To get your baby vaccinated for free, go to your nearest government hospital or get them from your ANM at the Village Health and Nutrition Day (VHND). 🏥	Day 28, 8am
Reinforcement message	Todays message for your family 👉: You are doing a great job by only feeding your baby breastmilk! 🤱👏 Breastfeeding is the first step towards protecting your child! ❤️ Here are some known (or recognized प्रमाणित) benefits for the mother if she only breastfeeds her baby and gives nothing else to the baby. 👍 👍 helps in postpartum weight loss. 👍 reduces the risk of cancers of the breasts and ovaries. The next step towards protecting your child is immunisation💉 - take a look at the MCP card (in KA -Thayee card) to check for the next date of vaccination and plan for the hospital visit! 🏥 If you like this message, give thumbs up👍	Day 31, 8 am
Reminder message	Todays message for your family 👉: Namaste! 🙏 your baby is due for vaccination💉 in a few days, do not forget to visit the Anganwadi centre or health center at 1.5 months (6 weeks) of age For more information, check the MCP card (in KA Thayee card) or speak to the ANM or ASHA worker regarding this.	Day 40, 8 am
Vaccination reminder 2	Todays message for your family 👉: Hope your baby has already been given the vaccines at 1.5 months of age! In case you have missed it, don't worry, you can still get the vaccine💉 by visiting the health center.	Day 46, 8 am
Vaccination reminder 3	Remember that the next vaccine is due at 2.5 month age of baby - refer to the MCP/thayee card or ask the ANM or ASHA worker about this. If you like this message, give thumbs up👍	Day 51, 8 am
Service end	This is the last message about mother and baby's health. If you have any questions about the mother and baby health, please ask us.	Day 51, 8 am

Table C.2: CONSORT 2010 checklist of information when reporting a cluster randomised trial

Section/Topic	Item No	Checklist Item	Extension for cluster designs	Page No
Title and abstract				
	1a	Identification as a randomised trial in the title	Identification as a cluster randomised trial in the title	Title
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)[i],[ii]	See table 2	Abstract
Introduction				
Background and objectives	2a	Scientific background and explanation of rationale	Rationale for using a cluster design	Methods Para 1
	2b	Specific objectives or hypotheses	Whether objectives pertain to the cluster level, the individual participant level or both	Intro Para 7, Methods Para 8
Methods				
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Definition of cluster and description of how the design features apply to the clusters	Methods Para 4-6
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons		Methods Para 5
Participants	4a	Eligibility criteria for participants	Eligibility criteria for clusters	Methods Para 4-5
	4b	Settings and locations where the data were collected		Methods Para 4
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Whether interventions pertain to the cluster level, the individual participant level or both	Methods 1-2
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Whether outcome measures pertain to the cluster level, the individual participant level or both	Methods 7-9
	6b	Any changes to trial outcomes after the trial commenced, with reasons		N/A
Sample size	7a	How sample size was determined	Method of calculation, number of clusters(s) (and whether equal or unequal cluster sizes are assumed), cluster size, a coefficient of intra-cluster correlation (ICC or k), and an indication of its uncertainty	Methods Para 4
	7b	When applicable, explanation of any interim analyses and stopping guidelines		N/A

(continued on next page.)

Randomisation				
Sequence generation	8a	Method used to generate the random allocation sequence		Methods Para 5
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Details of stratification or matching if used	Methods Para 5
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Specification that allocation was based on clusters rather than individuals and whether allocation concealment (if any) was at the cluster level, the individual participant level or both	N/A
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Replace by 10a, 10b and 10c	
	10a		Who generated the random allocation sequence, who enrolled clusters, and who assigned clusters to interventions	Methods Para 5
	10b		Mechanism by which individual participants were included in clusters for the purposes of the trial (such as complete enumeration, random sampling)	Methods Para 6
	10c		From whom consent was sought (representatives of the cluster, or individual cluster members, or both), and whether consent was sought before or after randomisation	Methods Para 6
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how		N/A
	11b	If relevant, description of the similarity of interventions		N/A
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	How clustering was taken into account	Methods 9-10
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses		Methods 9-10

(continued on next page.)

Results				
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	For each group, the numbers of clusters that were randomly assigned, received intended treatment, and were analysed for the primary outcome	Methods Para 4-6, Figure 1
	13b	For each group, losses and exclusions after randomisation, together with reasons	For each group, losses and exclusions for both clusters and individual cluster members	Figure 1
Recruitment	14a	Dates defining the periods of recruitment and follow-up		Methods Para 6-8
	14b	Why the trial ended or was stopped		N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Baseline characteristics for the individual and cluster levels as applicable for each group	Results, Table 1
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	For each group, number of clusters included in each analysis	Methods Para 10, Figure 1, Tables 3-4
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Results at the individual or cluster level as applicable and a coefficient of intracluster correlation (ICC or k) for each primary outcome	Results Tables 3-4
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended		Results Tables 3-4
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory		Results Table 2, Supplements S8-S9
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms[iii])		N/A

(continued on next page.)

Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	Discussion Para 2
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Generalisability to clusters and/or individual participants (as relevant)	Discussion Para 3
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	Discussion Para 1, 3-4
Other information			
Registration	23	Registration number and name of trial registry	Methods Para 4
Protocol	24	Where the full trial protocol can be accessed, if available	N/A
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	Acknowledgements and via online submission system as per journal's instructions

Notes:(Hopewell et al. (2008a,b); Ioannidis (2004))

Table C.3: High dimensional controls

S. No.	Panel A: Individual-level covariates
	Mother's demographic characteristics
1	Age of the mother
2	Gender of the baby
3	Primary respondent is the mother
4	Baby readmitted to the hospital after initial discharge
5	Vaginal or C-section delivery type
6	Number of previous births
7	First-time mother
8	Belongs to General social category
9	Belongs to SC/ST social category
10	Belongs to a Below Poverty Line household
11	Caregiver also responded to the survey in addition to the mother
	SES indicators
12	Roof material is concrete
13	Fuel type used in household is Liquified Petroleum Gas (LPG)
14	Toilet type used in household is not an open toilet
15	Household assets: own pressure cooker
16	Household assets: own color television
17	Household assets: own refrigerator
18	Household assets: own table
19	Household assets: own washing machine
20	Household assets: own sewing machine
21	Household assets: own air conditioner/cooler
22	Household assets: own mattress
23	Household assets: own motorcycle/scooter
24	Household assets: own none of the above assets
	Education
25	No formal schooling completed
26	Primary school completed
27	Secondary school completed
28	Higher than secondary school completed
	Occupation
29	Unemployed
30	Homemaker
31	Daily wage worker
32	Work in the private sector
33	Work in the public sector
	Panel B: Hospital-level covariates
34	Presence of a high-risk maternity ward
35	Number of staffed maternity nurses
36	Hospital provided support for CCP

Notes: This table provides the list of individual and hospital-level covariates that were used in the PDS-lasso model to select the final list of covariates for the estimation. Mother's demographic characteristics and SES indictors were collected as part of the demographic survey prior to offering enrollment in MCCP. Education and occupation were collected at the time of the follow-up survey. Hospital characteristics were collected by survey team by interviewing a member of the adminsitrative staff at each hospital in the study.

Table C.4: Demographic characteristics of excluded sample (N=3,466)

	mean	sd
Mother's age	24.35	4.053
Newborn is male	0.530	0.499
Primary respondent is the mother	0.975	0.155
Newborn readmitted to hospital after delivery	0.098	0.298
Vaginal delivery	0.676	0.468
First time mothers	0.267	0.443
Number of previous live births	1.396	1.210
Ownership of smartphone that supports WhatsApp	0.000	0.000
Category: General	0.054	0.225
Category: Scheduled caste/scheduled tribe	0.835	0.371
Category: Other	0.111	0.315
Ownership of a Below Poverty Line (BPL) card	0.560	0.496
SES index	-0.573	1.153
Ownership of household items		
Pressure cooker	0.501	0.500
Color television	0.426	0.495
Refrigerator	0.142	0.349
Table	0.125	0.330
Washing machine	0.040	0.196
Sewing machine	0.073	0.260
Air conditioner/cooler	0.163	0.369
Mattress	0.370	0.483
Motorcycle/scooter	0.267	0.442
None of these	0.294	0.456
Home roof material is concrete	0.534	0.499
Household uses LPG fuel mostly for cooking	0.717	0.451
Household uses open toilet	0.303	0.460

Notes: This table shows the means and standard deviations of the individuals surveyed during the demographic survey who did not meet the inclusion criteria and were excluded from the study. For binary characteristics, the proportion of participants is shown. The SES index is calculated using the methodology from the NFHS-4 and standardized around the control group.

Table C.5: Attrition by treatment assignment

	(1)	(2)	(3)	(4)
	Without controls		**With controls (all vars)**	
	β	**se**	**β**	**se**
Treatment group	0.029	(0.053)	0.014	(0.043)
Control mean	0.356		0.356	
Observations	21,930		21,930	
R-squared	0.093		0.117	

Notes: We exclude observations for individuals who do not meet the inclusion criteria. The attrition variable is an indicator which is 0 if the demographic survey respondent does not have a corresponding followup survey and 1 if they have a followup survey. The treatment variable is a indicator which is 0 for the control group and 1 for the MCCP treatment group. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.6: Demographic characteristics, by attrition

	Non-attrited (n = 13,491)		Attrited (n = 8,439)		Non-attrited vs. attrited	
	mean	sd	mean	sd	*p*-values	
Mother's age	24.329	3.715	24.546	3.989	0.396	
Newborn is male	0.523	0.499	0.524	0.499	0.834	
Primary respondent is the mother	0.979	0.143	0.931	0.254	0.014	**
Newborn readmitted to hospital after delivery	0.074	0.262	0.123	0.328	0.073	*
Vaginal delivery	0.533	0.499	0.589	0.492	0.049	**
First time mothers	0.242	0.428	0.273	0.446	0.090	
Number of previous live births	1.227	0.972	1.167	0.997	0.317	
Category: General	0.130	0.336	0.145	0.352	0.978	
Category: Scheduled caste/scheduled tribe	0.825	0.380	0.767	0.423	0.183	
Category: Other	0.045	0.207	0.089	0.284	0.026	**
Ownership of a Below Poverty Line (BPL) card	0.591	0.492	0.530	0.499	0.135	
SES index	0.072	0.955	-0.152	1.073	0.053	*
Ownership of household items:						
Pressure cooker	0.781	0.414	0.683	0.465	0.053	*
Color television	0.735	0.442	0.642	0.479	0.003	***
Refrigerator	0.392	0.488	0.402	0.490	0.030	**
Table	0.323	0.468	0.348	0.476	0.666	
Washing machine	0.132	0.338	0.170	0.376	0.999	
Sewing machine	0.222	0.415	0.236	0.425	0.972	
Air conditioner/cooler	0.301	0.459	0.323	0.468	0.208	
Mattress	0.599	0.490	0.395	0.489	0.371	
Motorcycle/scooter	0.598	0.490	0.473	0.499	0.053	*
None of these	0.057	0.232	0.098	0.297	0.036	**
Home roof material is concrete	0.644	0.479	0.772	0.419	0.919	
Household uses LPG fuel mostly for cooking	0.856	0.351	0.842	0.365	0.684	
Household uses open toilet	0.200	0.400	0.222	0.416	0.202	

Notes: This table shows the means and standard deviations of the participants that we were able to track and stayed in the study (non-attriters) versus those we lost to follow up (attrited). We exclude observations from participants that did not meet our inclusion criteria. For binary characteristics, the proportion of participants is shown. The p-value displayed is from a regression of the dependent variable on an indicator variable for treatment. State fixed effects are included, and standard errors were clustered at the hospital level (not shown here). The SES index is calculated using the methodology from the NFHS-4 and standardized around the control group. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.7: Baseline balance table of full demographic survey sample

	Control (n = 11,627)		Treatment (n = 13,769)		Treatment vs. Control	
	mean	sd	mean	sd	*p*-values	
Mother's age	24.327	3.826	24.468	3.880	0.712	
Newborn is male	0.527	0.499	0.523	0.500	0.935	
Primary respondent is the mother	0.975	0.155	0.952	0.214	0.421	
Newborn readmitted to hospital after delivery	0.127	0.333	0.065	0.247	0.097	*
Vaginal delivery	0.599	0.490	0.548	0.498	0.781	
First time mothers	0.235	0.424	0.274	0.446	0.065	
Number of previous live births	1.285	1.037	1.184	1.000	0.936	
Ownership of smartphone that supports WhatsApp	0.888	0.316	0.843	0.364	0.139	
Ownership of a smartphone currently being used for WhatsApp	0.898	0.303	0.849	0.358	0.104	
Category: General	0.127	0.333	0.122	0.328	0.555	
Category: Scheduled caste/scheduled tribe	0.836	0.370	0.783	0.412	0.763	
Category: Other	0.037	0.189	0.095	0.293	0.288	
Ownership of a Below Poverty Line (BPL) card	0.568	0.495	0.565	0.496	0.704	
SES index	0.000	1.000	-0.166	1.079	0.365	
Ownership of household items:						
Pressure cooker	0.749	0.434	0.677	0.468	0.365	
Color television	0.710	0.454	0.621	0.485	0.155	
Refrigerator	0.374	0.484	0.351	0.477	0.112	
Table	0.253	0.435	0.347	0.476	0.427	
Washing machine	0.105	0.307	0.155	0.362	0.542	
Sewing machine	0.228	0.420	0.188	0.390	0.660	
Air conditioner/cooler	0.339	0.473	0.248	0.432	0.548	
Mattress	0.492	0.500	0.507	0.500	0.672	
Motorcycle/scooter	0.549	0.498	0.480	0.500	0.697	
None of these	0.082	0.274	0.121	0.326	0.072	*
Home roof material is concrete	0.624	0.484	0.712	0.453	0.282	
Household uses LPG fuel mostly for cooking	0.801	0.399	0.859	0.348	0.353	
Household uses open toilet	0.290	0.454	0.163	0.369	0.134	

Notes: This table shows the means and standard deviations of the participants in the control and treatment groups at the time of recruitment and prior to any intervention. For binary characteristics, the proportion of participants is shown. The *p*-value displayed is from a regression of the dependent variable on an indicator variable for treatment. State fixed effects are included, and standard errors were clustered at the hospital level (not shown here). The SES index is calculated using the methodology from the NFHS-4 and standardized around the control group. * denotes statistical significance at 10 pct, ** at 5 pct, and *** at 1 pct level.

Table C.8: Effect of MCCP Intervention on newborn care, maternal diet, and complications, unadjusted (N=13,491)

Outcomes	Control mean	RD	95% CI	*p*-value	*q*-value
Newborn care					
Exclusive breastfeeding	0.499	0.005	[-0.105, 0.115]	0.929	0.485
Fed any breastmilk	0.941	0.068	[0.032, 0.104]	0.000 ***	0.001
Practiced recommended cord care	0.489	0.057	[0.003, 0.111]	0.000 ***	0.001
Mother practiced skin-to-skin with newborn	0.094	0.106	[0.070, 0.142]	0.000 ***	0.001
Father practiced skin-to-skin with newborn	0.010	0.021	[0.006, 0.036]	0.006 ***	0.015
Completed six week vaccinations	0.509	0.054	[-0.032, 0.139]	0.218	0.230
Maternal diet practices					
No reduction of food intake	0.697	0.065	[0.020, 0.110]	0.004 ***	0.012
No reduction of water intake	0.751	0.036	[-0.046, 0.118]	0.390	0.288
No restriction of food items	0.380	0.101	[0.061, 0.141]	0.000 ***	0.001
Consumed iron and folic acid supplements	0.124	0.083	[-0.003, 0.169]	0.059	0.093
Consumed calcium supplements	0.116	0.091	[0.013, 0.169]	0.023 **	0.042
Newborn and maternal complications					
Newborn admitted to hospital after discharge	0.068	-0.005	[-0.026, 0.015]	0.601	0.399
Newborn experienced complications after discharge	0.295	0.019	[-0.017, 0.054]	0.301	0.261
Mother admitted to hospital after discharge	0.012	0.003	[-0.003, 0.010]	0.272	0.256
Mother experienced complications after discharge	0.112	0.014	[-0.004, 0.032]	0.131	0.160
Experienced issues with cord care	0.056	-0.007	[-0.023, 0.009]	0.400	0.288

Notes: This table presents the unadjusted results of the logistic regression of the primary outcomes on treatment. Each row represents a separate regression. The same estimation specification as described for Table 3 was used, without the addition of the covariates. All outcome variables presented are indicators that are 0 if the behavior was not practiced, and 1 if the behavior was practiced. The treatment variable is an indicator that is 0 if they were assigned to the control group and 1 if they were assigned to treatment. Standard errors (not shown here) are robust, and are clustered at the hospital level. We present sharpened False Discovery Rate (FDR) adjusted *q*-values to correct for multiple hypothesis testing (Anderson (2008)). * denotes statistical significance for *p*-values at 10 pct, ** at 5 pct, and *** at 1 pct level. RD: risk difference; CI: confidence interval.

Table C.9: Effect of MCCP Intervention on newborn care, maternal diet, and complications, unadjusted (N=13,491)

Knowledge outcomes	Control mean	RD	95% CI	*p*-value	*q*-value
Know to breastfeed when mother has a fever	0.402	0.068	[-0.017, 0.152]	0.117	0.160
Know to breastfeed jaundiced newborn	0.535	0.070	[-0.013, 0.154]	0.097	0.145
Know age to start complementary feeding	0.683	0.022	[-0.085, 0.128]	0.689	0.400
Know recommended cord care	0.380	0.036	[-0.016, 0.087]	0.177	0.195
Know about skin-to-skin care	0.185	0.163	[0.110, 0.217]	0.000 ***	0.001

Notes: This table presents the results of the logistic regression of the knowledge outcomes on treatment. Each row represents a separate regression. The same estimation specification as described for Table 4 was used, without the addition of the covariates. All outcome variables presented are indicators that are 0 if they did not have the correct response to the knowledge question, and 1 if they did. The treatment variable is an indicator that is 0 if they were assigned to the control group and 1 if they were assigned to treatment. Standard errors (not shown here) are robust, and are clustered at the hospital level. We present sharpened False Discovery Rate (FDR) adjusted q-values to correct for multiple hypothesis testing (Anderson (2008)). * denotes statistical significance for p-values at 10 pct, ** at 5 pct, and *** at 1 pct level. RD: risk difference; CI: confidence interval.