

**The power of information and motivation on maternal and child health knowledge:
an application with ad-hoc SMS in Mexico's Prospera program[±]**

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Abstract

Access to information is a necessary, but not sufficient condition to achieve health improvements. In this paper, we evaluate the impact of four interventions that seek to improve maternal and early childhood health outcomes. The interventions being evaluated focus on empowering, motivating and providing behaviorally-designed messages delivered to beneficiaries by SMS. This paper (the first of a series) investigates the impact of the program on women's knowledge about adequate care practices, which is a key mechanism to achieve health improvements. For such purpose, an original battery of 21 questions was designed, gathered and analyzed. To assess the impact on knowledge, we compared the responses of two sets of women: one group had already received a key piece of information (through SMS), while the other were still about to receive it. By comparing both groups we find a 12 percent increase in the proportion of correct answers as a result of the information delivery. Interestingly, an intervention focused on framing messages by adding motivationally-charged content achieves an increase in knowledge even before receiving the information, but is later caught up by the rest of the interventions.

Keywords: mHealth, health knowledge, maternal and childcare knowledge, information

JEL codes: I12, I15, I38, J13

I. Introduction

Guaranteeing access to information as effectively as possible has been the objective of multiple health policy interventions. However, providing clear, reliable and relevant information is a necessary, but not sufficient condition to achieve health improvements. To reach this goal, the information recipient must understand, internalize and put in practice such information.

Maternal and early child care is an ideal context to study the development of this process that goes from information access to health improvements. This process is especially challenging in a development context where information recipients had poor access to education and where cultural and family ties have an important influence. Agents usually have beliefs about what are good health practices, typically acquired from close relatives' experience, cultural or religious beliefs. However, in the case of Mexico's Prospera program (as in many development programs), expecting mothers and infants are required to attend clinics to receive preventive checkups and information.¹ The information received during their checkups has a scientific basis and can either be unknown, contradictory or in line with the recipients' previous beliefs.

This paper tackles the first step of the process described above by analyzing how the provision of information affected the knowledge of recipients. The main findings suggest that beneficiaries increase their knowledge basis by 12 percent shortly after receiving information. The messages with the greater impacts were those focusing on "prevention and treatment of illness" and "child development". Meanwhile, those focusing on "baby appointments and protocols" and "maternal health" had negligible effects. Interestingly, a group of women that received a socio-emotional intervention focused on motivating mothers had a higher impact on knowledge even before receiving information. Access to

¹ Mexico has a long history of informative institutional strategies for maternal and child care, going from national information campaigns through massive communication media such as radio and television (e.g. folic acid intake campaign; prevention of mosquito transmitted diseases such as Zika, Dengue and Chikungunya) to bottom-up information distribution through posters, pamphlets, workshop materials, shown and handed to target population in primary health units and hospitals. An important federal initiative to distribute and update maternal and child health information known as *Arranque Parejo en la Vida* (Equal Start in Life) started in 2000. Prospera beneficiaries, in particular, must attend specific workshops, linked to the program conditionalities, focused on providing practical information on several topics, including pregnancy and child care.

information later allowed the control group, that is, women receiving information without any motivational framing, to catch-up with this group of women.

Outside the educational context, individuals are seldom tested about their knowledge of specific topics. Thus, few sources give insight about the level of knowledge that patients or mothers have. To our knowledge, the only general assessments about health knowledge occur through surveys. In this regard, data reported by the World Bank from 26 countries (mainly middle income level) indicates that 31% of women and 33% of men aged 15 to 49, have correct knowledge about HIV. Specifically looking at maternal health knowledge, 35% of pregnant women in Senegal, 45% in Malawi and 43% in Haiti could not mention at least one danger sign during pregnancy. Meanwhile, 39% of women aged 15 to 49 in Bolivia, and 12% in Dominican Republic have correct knowledge about the fertility period during the menstrual cycle. In the case of Mexico, the 2012 National Health and Nutrition Survey (ENSANUT) includes one question about maternal care knowledge. According to the survey, 23% of women over 20 years of age do not know the benefits of taking folic acid pills during pregnancy, 69% indicated that folic acid helps prevent birth defects and 8% mentioned other benefits.

A growing body of literature has shown how important is development at early stages of life and concludes that investments at this phase have high returns (Conti & Heckman, 2014). Children growing in less developed settings are at great disadvantage since differences with respect to babies growing in wealthy families begin this early. Mother investments and health indicators begin to lag behind since pregnancy. For example, only 69% of Prospera mothers that participate in our study report attending their first pregnancy checkup during their first trimester. This contrasts with 84% reported in ENSANUT from Mexican women in general.²

Our present study is the first of a series of papers that will document the impact of a set of interventions focused on improving maternal and child health through the provision of SMS messages. The design of our intervention seeks not only to provide information, but it

² Lack of knowledge directly or indirectly reflects in other indicators. According to ENSANUT 2012, only 14% of the babies receive exclusive breastfeeding during the first six months of life, 38% of babies aged 12 to 26 months present anemia, and 12.5% (17.8%) of babies aged 0-12 (13-24) months presented diarrhea in a period of 2 weeks before the survey.

contributes to the literature by: (i) crafting messages in a personalized ad-hoc fashion, (ii) increasing empowerment by allowing beneficiaries to evaluate the services received and giving them the possibility to reward suppliers, (iii) promoting community participation by allowing Prospera local leaders to send additional messages and to make a compromise regarding maternal care, and (iv) framing messages with a higher motivational and socio-emotional content. Through a randomized control trial we seek to isolate these different components. Our research will follow the process that goes from receiving the messages all the way to health indicator changes. In this paper we analyze the first step that links message delivery with increase in knowledge.

The evidence on health knowledge as an intermediate result and its casual impact on actual health outcomes is scarce. In contrast, a large literature exists to study the effects of mHealth programs.³ Glewwe (1999) finds an increase in child height associated with mothers' health knowledge. Similarly, Christiaensen & Alderman (2004) find an increase in child height associated with community's nutritional knowledge. Appendix 1 provides detailed information concerning existing research on the impact of health knowledge on health outcomes.

To be able to assess changes in knowledge, we designed 26 multiple choice questions and sent them to 916 beneficiaries. In total, we sent 2,851 messages and collected 592 valid responses, out of which 70% were correct responses and 30% were not. These questions were sent to beneficiaries that were either about to receive the message containing the information needed to correctly respond the question or that had just received such information from the program. Questions cover a wide list of topics that range from maternal health care to baby's development and nutrition. We are not aware of a more comprehensive list of questions about maternal and child health to evaluate beneficiaries'

³ The effect of information delivery through mHealth programs has been widely studied. Head et al (2013) present in their meta-analysis positive effects of these type of interventions in behaviors such as smoking cessation, physical activity, weight loss, medication and primary care appointment. Similarly, Lee et al (2016) realized a systematic review and meta-analysis of the effectiveness of mHealth interventions for maternal, newborn and child health in low and middle-income countries. Considering two RCTs they found a positive effect of mHealth intervention versus routine prenatal care on initiation of breastfeeding, on onset of lactation, and on exclusive breastfeeding for the first six months. Also, considering three RCTs they found a positive effect on exclusive breastfeeding for three or four months. Lund et al (2014, 2012) through an RCT implemented in Tanzania., found an increase in antenatal care attendance and skilled delivery attendance plus a significant reduction in perinatal mortality.

knowledge. Two concrete examples from our list of questions include asking mothers about the correct position in which babies should be put to sleep giving them “on their belly” or “on their back” as the two possible answers; and asking if it is fine to give 3-month-old babies chamomile tea to complement breastfeeding, giving them “Yes” or “No” as possible answers.

By comparing beneficiaries’ responses from two groups: those that had not received the relevant information needed to answer the question and those who had already received it, we find that the program increased knowledge by improving the proportion of correct responses from 67 percent to 75 percent, which is equivalent to an 8 percentage point (or 12 percent) increase. Comparing the different groups from the randomized intervention, women receiving motivational messages display better results before receiving the information. Nonetheless, women in the other groups catch-up after the information is sent. Some heterogeneity is found in terms of the topics of the questions, suggesting that mothers learn more from “prevention and treatment of illness” and “child development” messages.

Our research contribution in this paper is twofold. First, we provide innovative evidence about women’s knowledge in different aspects of maternal and child care by providing data from a comprehensive list of questions. Second, using a robust methodology, we give evidence of the impact of innovative variations of an mHealth intervention, which include personalized messages, community participation, women empowerment and socio-emotional motivation. The evidence is provided from the context of a marginalized population in Mexico.

The rest of the paper is organized as follows: section II describes the intervention and the different treatment arms; section III details the data collected, describes the questions sent to beneficiaries and shows how they relate to the information received through SMS as part of the intervention; section IV indicates the methodology followed for the econometric identification; section V presents the results; and section VI concludes.

II. Prospera Digital: an innovative maternal and early child health intervention

Prospera Digital (PD) is an mHealth program that seeks to improve maternal and child health by sending SMS text messages during pregnancy, puerperium, and the first two years of the baby's life. The beneficiaries receive personalized free text messages with health advice on maternal and child care, information to help them identify warning signs and act accordingly, and reminders of medical appointments and vaccinations. The message interaction is free to the users and its format is one-way (do not require a response) and two-way (require a response before sending a follow-up message). The messages are personalized and tailored to the specific circumstances of each participant using three sources of information: (i) beneficiaries' response to messages, (ii) Prospera administrative information, and (iii) clinical history information. In addition, the beneficiaries can prompt actions, such as reporting obstetric emergencies and concerns, health concerns or request appointment date changes. Message content is based on behavioral principles and strategies⁴ to incentivize a better understanding of the information and motivate healthy actions. The messages were designed by the Behavioral Insights Team (pregnancy and puerperium) and BabyCenter (newborns to 2 year old) and revised by Que Funciona para el Desarrollo and the Ministry of Health to ensure that content is consistent with the information that beneficiaries receive officially in health clinics.

The messages are distributed through RapidPro, a platform developed by Nyaruka and UNICEF, which allows automated SMS delivery. Messages are sent on fixed dates relative to the due date or the baby's birthday; this allows to send the messages when the information is relevant for the users.⁵ RapidPro also stores the responses and information related to them (e.g. sender, date and time of message, errors in sending the messages).

A randomized experiment was designed to measure the impact of four program variations. During the first stage of the project, three treatment arms were designed and implemented. Personalized messages form part of all treatment arms. Treatment arm 1 consists of

⁴ These include adding the name of the mother and/or baby, sending further information based on the user's response, indicating percentage of people that comply a specific action to appeal to availability, and using motivational framing, among others.

⁵ Table , Table and **Error! Reference source not found.** in the appendix show the structure of the frequency and classification of messages.

messages exclusively and hereon we will refer to it as the “main treatment arm.” Two components were added to the program in addition to the messages in order to assess if they provide any added value to the main treatment arm. The first added component consists in the participation of community leaders,⁶ who perform two main tasks. They are enabled to send predefined text messages with the purpose of reinforcing health information. They also sign with beneficiaries a voluntary and non-enforceable “contract” during the program sign-up, which consists of three alternative commitments: taking their folic acid pills, attending their checkups or replying to all PD messages. Treatment arm 2 consists of messages plus this component and its comparison to treatment arm 1 will enable us to estimate the added benefit of the community leaders’ participation.

The second added component enabled beneficiaries to evaluate, anonymously, the services and medical care they receive in their health centers. This evaluation asked women if specific protocols were followed during their checkups and details of their appointments (e.g. blood pressure taken, waiting time). Based on the women’s feedback, incentives are granted to the health providers in the clinics with better scores. Clinic scores are segregated by state and rural/urban classification to make the comparison between more homogenous clinics. Women know ex-ante that their responses matter to assign the prizes and medical personnel know that beneficiaries define prizes with their feedback, although they do not know who is receiving the questions and which are the questions being asked. Treatment arm 3 consists of messages plus this component and its comparison to treatment arm 1 will give information about the women empowerment and incentives to clinics.

Random assignment is done at the clinic level. In total we have 655 clinics located in five states of Mexico: Chiapas, Guanajuato, Hidalgo, Puebla and the State of Mexico. Treatment groups were distributed as follows: 107 to treatment 1, 111 to treatment 2, 108 to treatment 3, and 329 received no intervention and were kept as a control group. The program rollout began in December 2015 through sign-up events where beneficiaries are given information

⁶ Community leaders consist of: (i) vocales, who are Prospera community representatives whose responsibility is to provide information about the program, are elected by the community, and participate on a voluntary basis, meaning they are not paid; and (ii) health auxiliaries, who are directly linked to the clinic to contribute with public health actions and establish a link with beneficiaries.

about the program, sign-up information is collected⁷ and where mobile phones are given to beneficiaries that do not own one (30% of participants received a phone). Each clinic had two rounds of sign-up events with at least six months difference between each other. All pregnant Prospera beneficiaries with less than 32 gestation weeks were invited. A total of 3,236 beneficiaries signed-up and received messages.

The fourth intervention resulted from fieldwork in which beneficiaries repeatedly gave evidence of emotional attachment to the messages.⁸ In this variation of the main intervention, beneficiaries receive a set of messages highly charged with socio-emotional content.⁹ The control group receives the conventional message set with modifications to remove socio-emotionally charged content. In the design of this treatment arm (hereon socio-emotional treatment), we made sure that both groups receive the same health information and that the only difference is in format and form, not health content. The socio-emotional treatment involved only beneficiaries from the second sign-up round in Chiapas and the State of Mexico. Beneficiaries were randomly assigned to the socioemotional treatment or control groups on an individual basis and attend clinics from all the previous treatment groups.

The impact evaluation of Prospera Digital aims to assess effects of the described interventions on the following areas: knowledge, habits and mothers' actions, empowerment, health and developmental outcomes. This paper takes a first step by looking at potential effects on knowledge, which is a key mechanism in this project.

⁷ Sign-up information includes: phone number, Prospera ID, due date (double-checked with his clinic records), age, information about previous pregnancies, literacy, language spoken (Spanish or indigenous dialect), identify if current pregnancy is considered risky.

⁸ This was confirmed by the fact that beneficiaries repeatedly sent "Thank you" messages in response to the SMS they were receiving as part of the program.

⁹ Socio-emotional content includes motivating tips, challenges to follow healthy habits or actions, congratulation messages and frequent mentions of the names of the user and her baby.

III. Measuring maternal knowledge about pregnancy and child care

Evidence about health knowledge, including maternal and child care, generally comes from individual surveys¹⁰. Learning about women's understanding of good health practices is a key aspect in public health provision since often parents' actions and perceptions are affected by religious or cultural beliefs. In the specific case of maternal and child care, family ties such as the individual's mother, mother-in-law, and other close relatives tend to be important sources of information. This could be inappropriate if the information that they provide is inaccurate, not based on scientific facts, and based on religious, cultural beliefs or purely past experiences. Furthermore, on the supply side, information provision is usually based on an analysis of diseases prevalence among the general or specific populations by health authorities, however, there does not seem to be a previous rigorous assessment of information sources or actual health knowledge of the target population. Therefore, public health provision faces a complex task since providing information that do actually changes knowledge is not easy. For this reason, building information about women's knowledge is very important.

With the aim of measuring knowledge, 21 multiple-choice questions were designed.¹¹ The questions ask about specific facts that beneficiaries receive in the program messages. Questions include general interest knowledge (such as breastfeeding) and beliefs that we consider are heavily influenced by tradition, cultural or religious norms (such as giving babies tea to treat stomachache). We classified the questions in five broad topics: (i) baby care and development, (ii) attention and prevention of baby's diseases, (iii) check-ups and medical protocols, (iv) nutrition, and (v) maternal health. These questions were sent through SMS messages, which allowed us to collect responses from the beneficiaries. Table

¹⁰ General health literacy measurement efforts have taken place, particularly in developed countries. For example: OECD 2015, Sorensen et al 2013, Suka et al 2013, Kutner et al 2015. However, broad efforts to document knowledge about maternal and child care are scarcer. National health surveys might include few questions on the topic for specific purposes (for example one question regarding acid folic acid intake in ENSANUT 2012 in Mexico in order to assess a campaign success); however, chronic diseases are usually the focus of any additional information or knowledge assessment through health surveys.

¹¹ In addition, some questions were designed to gain knowledge about women practices (such as if it is right to spank children) and perceptions (such as when babies begin to crawl). These questions were not added in our analysis because we want to measure theoretical knowledge that beneficiaries gain from the messages and not knowledge or perceptions that could be affected by their child development and actions.

1 shows the complete set questions. It also includes as reference the PD message with the key information content that would help beneficiaries to answer correctly the question.

Given that our purpose was to evaluate if information improves knowledge, questions were sent to two groups of beneficiaries: those who were about to receive the PD message with key information related to each question, and those who had recently received it.¹² In most cases, questions were sent within a seven day window of receiving the PD message.

Nevertheless, the period varied a little for some questions to include more beneficiaries.

The questions were designed to cover different development stages and were sent on three different dates during year 2017: March 17-19, May 26-31, and October 5-6.¹³

Table 2 contains some statistics for each of the questions. A total of 2,851 question messages were sent successfully to the beneficiaries. The average response rate was 21%, which amounts to a total of 592 questions for which we have a valid response. On average, beneficiaries that responded to the message before receiving the information achieve 67% of correct answers, while those that responded after the information was received obtained 75% correct responses on average.

A relevant aspect of our data is that beneficiaries that respond do not reflect a random sample of the beneficiaries' population. This is important to be cautious in terms of the external validity of the results. Table A3 in the appendix shows some characteristics in which respondents and non-respondents differ. For example, people that responded are significantly more likely to speak Spanish, to have signed-up to the program by themselves and less likely to have received a mobile during the sign-up (more likely to use their own).

¹² To give an example, the question about tuberculosis is linked to a PD message sent on the 6th day of the 43rd week of life of the baby. The question was sent to the beneficiaries whose babies are mostly between the 42nd and the 45th weeks.

¹³ Figure A.1 indicates the histograms with the gestational (developmental) age when the questions were sent.

IV. Identification strategy

Our strategy consisted in sending the questions to women within a short window of receiving the key information content to answer the question. We assume that those women that receive the question just before receiving the information content are at their status-quo in terms of knowledge. In contrast, the women responding after receiving the information benefit from it and might be better able to correctly answer the question. The key assumption towards our identification is that both groups of women are different because one group already received information, but other than that, they are undistinguishable in terms of characteristics. Table 3 gives evidence about this using observable characteristics for both group of women and show that they are balanced on a set of categories.

Our main estimation is the following:

$$Correct_{ik} = \delta_k + \tau \cdot After\ info_i + \beta' X_i + U_{ik} \quad (1)$$

where $Correct_{ik}$ is a dummy variable indicating if women i responded correctly to message k , $After\ info_i$ is a dummy indicating if women i belongs to the group that already received the relevant message, δ_k are fixed effects by message and X_i is a set of controls. Standard errors U_{ik} are clustered at the respondent level. The main parameter of interest is τ , which indicates the average difference of correctly responded questions between the group that already received information and the group that hasn't.

To analyze the differences in the effect of receiving the information by treatment, the following specification is employed:

$$Correct_{ijk} = \delta_k + \sum_{j=1}^4 (\theta_j \cdot T_j + \tau_j \cdot T_j \cdot After\ info_i) + \beta' X_i + U_{ik} \quad (2)$$

where T_j corresponds to four treatment dummies, one per Prospera Digital treatment group as described in section II: T_1 corresponds to the main treatment arm (i.e. receiving messages), T_2 corresponds to community leaders added participation, T_3 adds to messages the evaluation of clinic personnel by users, and T_4 corresponds to socio-emotional added content. In this specification, the parameters θ_j give the difference between treatment groups j when information has not been received and τ_j gives the effect of receiving information by treatment group j .

The selected sample includes beneficiaries who had already received the key content, 43 days ago at most, or who were expected to receive that content in a maximum of 20 days. A total of 916 beneficiaries received the knowledge questions; 649 of them received only one question, the rest received more than one and up to eleven questions. Only one question per day was sent to the beneficiaries who received multiple questions.

Table A3 gives descriptive characteristics of the beneficiaries for whom responses were gathered. As shown, they are 28.3 years on average, they had 1.9 previous pregnancies, 14% are going through a pregnancy classified as risky and 24% received a mobile to participate in the program.

V. Results

Table 4 shows the main results obtained by estimating equation (1). Throughout the different estimations, the analysis shows an 8 percentage point increase in the proportion of correct responses. Compared to the average level of correct responses before information is received, which is 67 percent, this increase represents a 12 percent increase in the proportion of correct answers. Figure 1 shows that the set of most effective messages (based on the increase in the proportion of correct answers) seem to be those focused on “prevention and treatment of illness”, closely followed by “baby development” and “nutrition”, although only the first type of messages achieved an improvement in correct responses over the 5% significance level. Figure 2 shows an estimation using a regression discontinuity strategy. In this case, the running variable is the difference in days between the response to the question and the day in which the information was received. The graph suggests there is an instant increase in the proportion of correct answers in the order of almost 20 percentage points, but less efficiently estimated. Moreover, as time passes, the proportion of correct answers goes down, which raises the question of the retention that mothers have of the information.

Table 5 displays the results by treatment group. First, the three treatments that were originally designed as part of the program are compared. Panel A results conclude that the

three treatment groups do not display a statistically significant differences between them. Next, the original treatment groups and the socio-emotional groups are compared in Panel B. The results suggest that women receiving socio-emotional messages throughout the program's operation display better knowledge even before receiving the relevant information. After information is delivered, such difference statistically disappears. A possible explanation for these results comes from the fact that women receiving socio-emotionally motivated messages might be paying more attention to information received from other sources (e.g. their clinic visits) and be more engaged. Our estimates find a statistically significant difference in proportion of correct answers (around 30 percentage points) between those receiving socio-emotional messages and those receiving the normal set before information has been received. Such difference disappears after the group receiving the normal set receives the information messages.

The estimations are robust to the use of different controls or different sets of fixed effects as evidenced by the stability of the results between different columns. The magnitude of the results is not negligible. As the education literature portrays, increases in knowledge (typically measured through standardized tests) in the order of 0.1 standard deviations is considered high. In our case, the main effect estimated would be in the order of 0.15 standard deviation increase.

VI. Conclusions

Our analysis gives novel evidence about the knowledge that pregnant beneficiaries or mothers have about care practices. Our findings use this information to estimate an 8 percentage point increase in the knowledge of beneficiaries as a results of the implementation of a project that focuses on information provision behaviorally motivated. Among the intervention variations, the delivery of socio-emotionally charged messages seems to have a significant effect on women's knowledge even before receiving the relevant information from the program.

Gaining insights about the women's knowledge and understanding is, in our opinion, a key factor that should inform the development of policies that focus on service and information provision. Nonetheless, the increase in knowledge is only the first step in a chain of factors that need to be improved in order to reach the goal of improving beneficiaries' health. The next steps of this project will look into the following links.

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Table 1
Questions to assess knowledge

Category	Topic	SMS information	Question
Attention and prevention of baby's diseases	Baby's warning signs	If your baby has trouble breathing or feeding or is too hot, cold, floppy or stiff or has a bluish color, take him to hospital immediately.	If your baby is flaccid like a rag doll or bluish, you should: 1) Breastfeed him 2) Let him rest 3) Take him to the hospital
	Diarrhea	Breastfeeding helps prevent diarrhea. So does washing your hands. Have you been washing your hands with soap regularly?	What can you do to protect your baby against diarrhea? 1) Give him tea 2) Wash your hands before touching him 3) Rub his belly
	Throat	If your child has a sore throat, keep feeding her as usual. Try soft foods to soothe her throat. Get her checked at the health center.	What's better to give your baby for a sore throat? 1) A tea spoon of honey 2) Chamomile tea or 3) Soft food.
	Jaundice	Your baby's eyes and skin may develop a yellowish tinge a few days after birth. It is a sign of jaundice. Sun bathe him and take him to the clinic if you notice it.	Is it a good idea to sun bathe your child for a short period of time if his skin or eyes are yellow? Send 1 if true or 2 if false.
	Tuberculosis	Chest pain and a cough that last over 3 weeks are signs of TB. Get treatment at a clinic if you or your baby have these signs.	What symptoms does a baby have if he has tuberculosis? 1) Chest pain and cough for more than 3 weeks, 2) Diarrhea for more than 2 days, 3) Irritated skin.
Baby's care and development	Teeth	Brush your child's teeth after every meal. This prevents diseases. Use a toothbrush with a small and soft head, and toothpaste, if you can.	It's unnecessary to wash a baby's teeth because they will eventually fall off. Answer 1 if this is true or 2 if this is false.
	Sleep	It is best not to share a bed with your baby. Always put him to sleep on his back, even when napping. Don't put pillows or toys in his cot. This prevents accidents.	Your baby shall always sleep face down during the night and during his nap times. Send 1 if true or 2 if false.
	Stools	Newborn baby poo is black then turns yellow. If there's blood or mucus in the poo or if it's white, check the health booklet and go to hospital.	A newborn's poop is first black then yellow. Send 1 if true or 2 if false.
Baby's check-ups and medical protocols	Baby's check-ups	We would like to know how your baby's appointment at 7 days went. Did you take him to the health center? Make sure you take him for all the check-ups indicated in his health card.	A healthy baby requires to get a check-up and vaccines in the health clinic only once a year. Send 1 if true or 2 if false.

Category	Topic	SMS information	Question
	Baby's protocols	Remember that your baby needs to be screened and have TB and Hep B vaccinations at birth. They will protect him from these diseases.	When should your baby get a screening, receive his first vaccines and get his immunization card? 1) at birth, in the hospital 2) at the 3 months check-up 3) At 6 months of age.
	Check-ups after 1 st birthday	Your child needs check-ups at least every 6 months. Check the health booklet to see when his next check-up is. If anything worries you, see a health worker soon.	After turning 1 year old your baby needs to go to the Health Center for revision at least: 1) every month 2) every 6 months 3) every year.
Baby's nutrition	Meat	Your baby can eat meat now. Try giving him chicken, turkey or beef. Meats like liver, heart and kidney are cheaper and just as good. Cook them well.	You can start feeding your baby mashed meat at the age of: 1) 5 months 2) 9 months 3) After 12 months.
	Iron	Feed your baby iron-rich foods. Cook them well. Iron helps your baby grow and be bright and alert. Do you know which foods are rich in iron?	Giving iron-rich foods to your baby will help him: 1) grow and be alert , 2) reduce cholesterol, 3) speak faster.
	Exclusive breastfeeding 1	When your baby is born, breastfeed him as soon as possible and whenever he is hungry. Your breastmilk is all he needs for the first 6 months.	Up to what age you must only feed breastmilk to your baby? 1) 3 months 2) 6 months 3) One year.
	Exclusive breastfeeding 2	Some people may advise you to give your baby water, tea or animal milk. They can harm your baby. Don't feed her anything other than your milk.	Besides breastmilk, it's ok to give chamomile tea to your baby after he is 3 months old. Send 1 if true or 2 if false .
	Vitamin D	Give your child foods which contain vitamin D like oily fish, eggs and liver. This will help him grow healthy bones and fight infections.	Is it true that beans, chards and spinaches are vitamin D rich foods? Answer Yes or No .
Maternal health	Birth	If your baby starts to come early, your body will tell you. If your waters break, you have contractions, or feel the desire to push, go straight to hospital.	Which one of the following is a signal that your baby's birth is coming? 1) colic once a day 2) diarrhea or loose stools 3) waters breaking .
	Family planning	Start thinking about spacing your babies. It's best to wait until your baby is at least 2 years old before you get pregnant again.	How much time must you wait for your body to fully recover before having another baby? 1) Six months 2) A year 3) Two years .
	Blood pressure	High blood pressure can be dangerous. Make sure you get it checked every time you visit the health center. You can help: Try to eat less salt.	Is it true that eating less salt helps preventing a rise in blood pressure? Send 1 if true or 2 if false.
	Warning signs during pregnancy	If you have a strong headache, like you head is going to exploit, go immediately to your health unit or	If you have bleeding, fever or you feel your head exploding you must: 1) send the message MICITA 2)

Category	Topic	SMS information	Question
		call the emergency line for assistance.	Go to your health clinic 3) Take an aspirin.
	Bleeding during pregnancy	If you have vaginal bleeding, fever, or pain, you may need fast treatment. Go to hospital immediately or the emergency line for assistance.	Bleeding during pregnancy is normal. Send 1 if true or 2 if false .

Table 2
Message flow response rates and correct responses differencing if
response is sent before or after information is received

Flow	Total messages	% Responses		Total valid responses	% Correct responses	
		Invalid	Valid		Before info	After info
Baby's warning signs	200	76%	24%	48	83%	88%
Diarrhea	163	79%	21%	35	88%	70%
Throat	140	89%	11%	15	0%	29%
Jaundice	153	73%	27%	41	50%	65%
Tuberculosis	109	86%	14%	15	50%	80%
Teeth	125	88%	12%	15	55%	100%
Sleep	339	85%	15%	52	50%	52%
Stools	196	73%	27%	53	78%	89%
Baby checkups	171	78%	22%	38	93%	71%
Baby's protocols	117	87%	13%	15	75%	86%
Check-up after 1st bday	88	95%	5%	4	67%	100%
Meat	99	88%	12%	12	44%	67%
Iron	117	90%	10%	12	86%	40%
Exclusive breastfeeding 1	230	65%	35%	81	65%	70%
Exclusive breastfeeding 2	91	67%	33%	30	50%	72%
Vitamin D	121	88%	12%	15	50%	20%
Birth	107	80%	20%	21	100%	85%
Family planning	52	75%	25%	13	100%	92%
Blood pressure	110	60%	40%	44	95%	100%
Warning signs pregnancy	109	76%	24%	26	60%	90%
Bleeding during pregnancy	14	50%	50%	7	100%	100%
TOTAL	2851	79.2%	20.8%	592	67%	75%

* An invalid response is considered when either the answer does not make sense or is inexistent

Table 3

Balance of characteristics if response arrives before vs after information is sent

Variable ²	Mean	Mean ¹		Difference ³
		Before	After	
Age	27.64	28.25	28.29	-0.041
Can read a message ^D	0.97	0.97	0.94	0.032
Num of previous pregnancies	1.15	2.05	1.96	0.089
Risky pregnancy ^D	0.08	0.17	0.12	0.041
Previous risky pregnancies ^D	0.19	0.17	0.19	-0.027
Rural locality ^D	0.57	0.62	0.60	0.026
Clinic in the locality ^D	0.73	0.79	0.74	0.054
Signed-up remotely ^D	0.08	0.06	0.06	0.009
Received a mobile ^D	0.14	0.20	0.26	-0.055
Num. of observations	592	179	413	

¹ Mean of variables comparing characteristics of women that responded before or after the information message was received

² Superscript "D" indicates if the variable is a dummy

³ Difference is significant at 10% (*), 5% (**) or 1% (***)

Table 4
Main regression results

VARIABLES	(1) Correct	(2) Correct	(3) Correct	(4) Correct	(5) Correct
After Info ¹	0.080* (0.0409)	0.083** (0.0417)	0.081** (0.0405)	0.078* (0.0409)	0.082** (0.0413)
State FE	No	Yes	No	No	Yes
Type of message FE	No	No	Yes	No	Yes
Controls ²	No	No	No	Yes	Yes
Observations	592	592	592	592	592
R-squared	0.007	0.010	0.058	0.011	0.064
Avg. before info	0.670	0.670	0.670	0.670	0.670

¹ Dummy equal to one if the respondent answers after the information has been received

² Controls include beneficiaries age, dummies to indicate first pregnancy, if the beneficiary received a mobile and if pregnancy is identified as risky pregnancy

Standard errors clustered by respondent in parenthesis

*** Significant at 1%, ** significant at 5%, * significant at 10%

Table 5
Regression results by treatment group

VARIABLES	(1) Correct	(2) Correct	(3) Correct	(4) Correct	(5) Correct
<i>Panel A: Differences with Treatment Groups T1, T2, T3</i>					
Treatment 2	0.062 (0.0976)	0.065 (0.0996)	0.070 (0.0942)	0.051 (0.0979)	0.060 (0.0952)
Treatment 3	0.022 (0.1039)	0.024 (0.1053)	0.036 (0.1026)	0.026 (0.1055)	0.047 (0.1049)
T ¹ x (Treatment 1)	0.074 (0.0744)	0.076 (0.0743)	0.099 (0.0770)	0.060 (0.0736)	0.088 (0.0748)
T ¹ x (Treatment 2)	0.081 (0.0693)	0.088 (0.0702)	0.056 (0.0710)	0.088 (0.0695)	0.069 (0.0736)
T ¹ x (Treatment 3)	0.058 (0.0909)	0.056 (0.0941)	0.060 (0.0879)	0.055 (0.0925)	0.055 (0.0934)
<i>Panel B: Differences with Socio-emotional Treatment Group</i>					
Treatment SE	0.250*** (0.0826)	0.351*** (0.0920)	0.208** (0.0825)	0.244*** (0.0842)	0.307*** (0.0917)
Treatment Non-SE	0.196** (0.0918)	0.276*** (0.0915)	0.150 (0.0924)	0.204** (0.0925)	0.242*** (0.0894)
T ¹ x (Treatment SE)	-0.094 (0.0641)	-0.095 (0.0653)	-0.096 (0.0673)	-0.096 (0.0660)	-0.094 (0.0701)
T ¹ x (Treatment Non-SE)	0.035 (0.0822)	0.041 (0.0797)	0.064 (0.0838)	0.036 (0.0828)	0.068 (0.0802)
T ¹ x (Treatment First Round)	0.153*** (0.0576)	0.166*** (0.0566)	0.141** (0.0560)	0.146*** (0.0555)	0.142*** (0.0542)
State FE	No	Yes	No	No	Yes
Type of message FE	No	No	Yes	No	Yes
Controls ²	No	No	No	Yes	Yes
Avg. Before First Round	0.568	0.568	0.568	0.568	0.568

¹ Dummy equal to one if the respondent answers after the information has been received

² Controls include beneficiaries age, dummies to indicate first pregnancy, if the beneficiary received a mobile and if pregnancy is identified as risky pregnancy

Standard errors clustered by respondent in parenthesis

*** Significant at 1%, ** significant at 5%, * significant at 10%

Table 6
Regression discontinuity estimates

VARIABLES	(1) Correct	(2) Correct	(3) Correct	(4) Correct	(5) Correct
RD estimate	0.054 (0.2630)	0.111 (0.1921)	0.167 (0.1611)	0.205 (0.1418)	0.237* (0.1341)
Polynomial	Cuadratic	Cuadratic	Cuadratic	Cuadratic	Cuadratic
Bandwidth ¹	10	15	20	25	30
Observations	221	307	382	452	484

¹ Optimal bandwidth is h=20

Robust standard errors in parenthesis

*** Significant at 1%, ** significant at 5%, * significant at 10%

Figure 1
Effects of receiving information by message classification

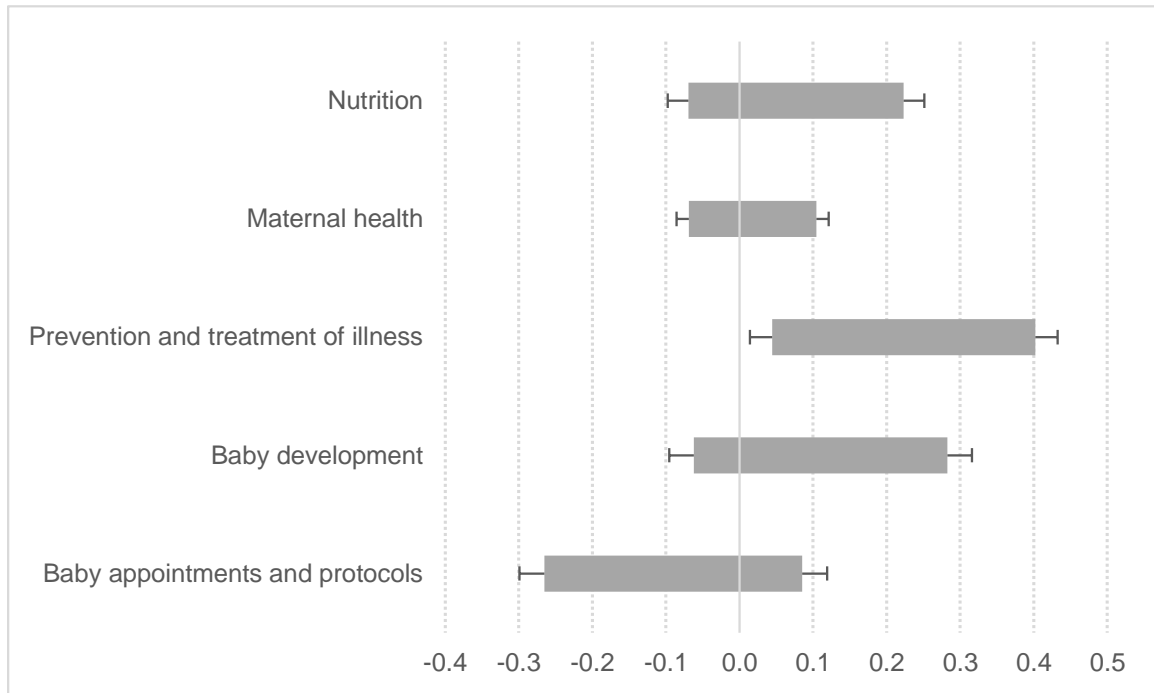
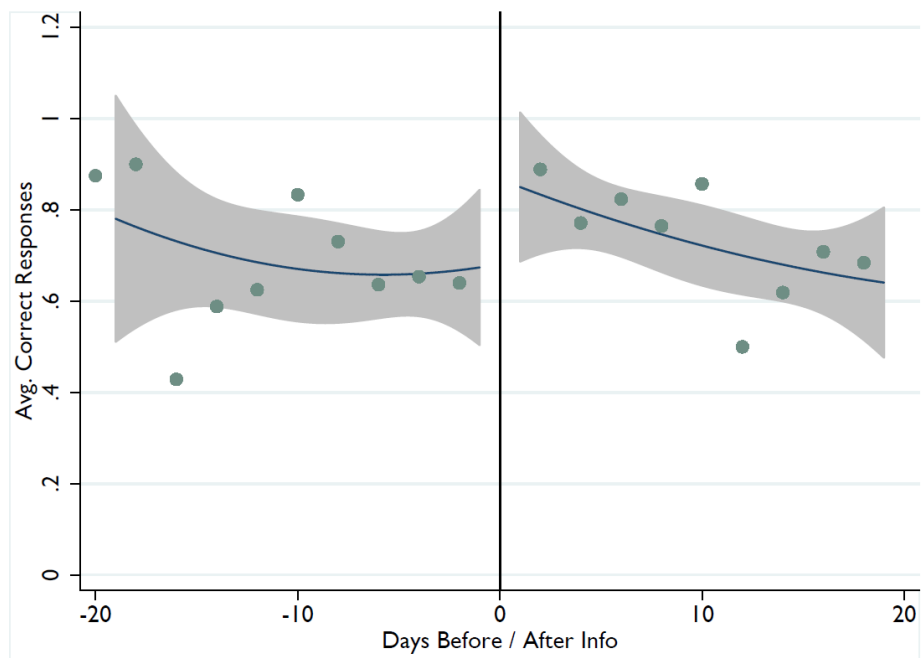


Figure 2
Regression discontinuity main estimation



Appendix 1. Additional literature

Reference	Country	Description of the intervention/study	Method and health knowledge proxy	Results
Glewwe, Paul. Why Does Mother's Schooling Raise Child Health in Developing Countries? Evidence from Morocco. <i>The Journal of Human Resources</i> , Vol. 34, No. 1 (Winter, 1999), pp. 124-159.	Morocco	Survey analysis to understand mechanisms that may explain the association between education and child health (approximated with child height). Possible mechanisms are: (i) Formal education directly teaches health knowledge to future mothers; (ii) literacy and numeracy skills acquired in school assist future mothers in and treating child health problems; and (iii) Exposure to modern from formal schooling makes women more receptive to modern treatments.	IV for mother's knowledge with community fixed effects. Instruments: i) number of married sisters of the mother and of her husband; (ii) mother's parents' education; and (iii) mass media variables (number of radios and televisions and availability of newspapers). Mothers health knowledge is measured with five questions on vaccination, treating infections, polio, diarrhea and safe drinking water.	When health knowledge is specified as endogenous such knowledge has a strong and statistically significant impact on child health, the biggest observed effect of a correct knowledge answer increases height for age Z-scores in 2.02 units. Health knowledge appears to be the most important skill that mothers indirectly obtain from schooling that contribute to their children's health.
Christiaensen L, Alderman H. Child Malnutrition in Ethiopia: Can Maternal Knowledge Augment the Role of Income? <i>Economic Development and Cultural Change</i> , Vol. 52, No. 2 (January 2004), pp. 287-312	Ethiopia	Exploration of the complementary role of nutritional knowledge on child malnutrition through the analysis of pooled individual, household, and community-level data from three nationally representative surveys.	OLS with and without price effects and a regional fixed effects model. Mothers' capability to correctly assess their children's nutritional status is used as a proxy for community's nutritional knowledge. Non-household cluster average of households' assessments are used to avoid the endogeneity in individual assessment.	Children in communities where all stunted children are rightly diagnosed as stunted are 0.12 z-scores taller than those in communities where none of them is identified as stunted.
Frost MB, Frost R, Haas DH. Maternal education and child nutritional status in Bolivia: finding the links. <i>Social Science & Medicine</i> 60 (2005) 395-407.	Bolivia	Modelling of various pathways linking maternal education and child nutritional status in Bolivia with survey data analysis. The analyzed pathways are: socioeconomic status, health knowledge, modern attitudes towards health care, female autonomy, and reproductive behavior.	Logistic regression with geographic controls. Indirect measures were used to create an index of general health knowledge: correct use of oral rehydration therapy, knowledge of any type of modern contraception, knowledge of AIDS, knowledge of the ovulatory cycle, and knowledge of a national health program guaranteeing free services.	Socioeconomic status and utilization of modern health facilities appears as the most important pathways of influence between maternal education and child nutritional status. The proportion of the education effect explained by health knowledge is 0.148.
Vikram K, Vanneman R, Desai S. Linkages between maternal education and childhood immunization in India. <i>Social Science & Medicine</i> 75 (2012) 331-339.	India	Examination with survey data analysis of four possible pathways that may mediate the influence of maternal education on childhood immunization: greater human, social, and cultural capitals and more autonomy within the household.	Logistic regressions with sampling cluster fixed effects. Health knowledge was approximated with three questions: (i) if it is harmful to drink one or two glasses of milk every day during pregnancy, (ii) if colostrum is beneficial for the child, and (iii) if a child needs to be given more than usual water to drink during diarrhea.	Each of the three health knowledge questions had a strong positive association with immunization. The human capital measures explained roughly 0.1 of the education effects.
Block S. Maternal Nutrition Knowledge versus Schooling as Determinants of Child Micronutrient. <i>Oxford Economic Papers</i> , New Series, Vol. 59, No. 2 (Apr., 2007), pp. 330-353.	Bangladesh	Identification of the distinct roles of maternal schooling versus maternal nutrition knowledge as determinants of micronutrient status through survey data analysis.	IV. Village mean distance to the nearest health instruments for nutrition knowledge and the size per adult equivalent of a household's house instruments for expenditures. Knowledge is approximated based on mothers' knowledge benefits of consuming vitamin A.	Maternal education effects on child micronutrient status are partially mediated through maternal nutrition knowledge and household expenditures. Maternal schooling and nutrition knowledge substitute for one another. Nutrition knowledge is also shown to be a positive function of maternal schooling, but schooling is only one of several sources of nutrition knowledge.
Johnson D et al. Original research article: A randomized controlled trial of the impact of a family planning mHealth service on knowledge and use of contraception. <i>Contraception</i> Volume 95, Issue 1, January 2017, Pages 90-97.	Kenya	The study estimates the effect of m4RH, an mHealth service in Kenya that provides family planning information via text message, on consumers' knowledge and use of contraception.	RCT.	The intervention increased scores on a test of contraceptive knowledge by 14 percent, but did not increase consumers' use of contraception, likelihood of discussing family planning with their partners, or likelihood of visiting a clinic to discuss family planning.

Appendix 2. Messages with relevant information to answer the questions

Topic	Period	Message	Follow-up 1	Follow-up 2
Concerns	Week 30 of pregnancy	Gradual swelling of hands or feet is common. But sudden swelling is not. Have you had sudden swelling in your face, hands, legs or feet?	<p>Yes: Sudden swelling is a danger sign. Let someone from your family know and go to hospital or call 01 800 628 37 62* for assistance.</p> <p>No: Good. But remember, Sudden swelling is a danger sign. Let someone from your family know and go to hospital or call 01 800 628 37 62*.</p>	
Breastfeeding	Second week of the life of the baby	Your breastmilk makes your baby strong. Feed him 8-10 times a day, with night time feeds too (approx. every 3 hours). Don't give him anything else.		
Development	Week 28 of the life of the baby	Slowly but surely your baby is becoming more independent! He may be able to roll over and sit up without support. If you are worried, go to a health centre.		
Planning	Week 32 of pregnancy	Most mothers give birth in a hospital and have a healthy birth. Have a plan on how to get to hospital. Have the money for transportation and other costs ready. Are you planning to give birth in a hospital? Y/N	<p>Yes: Good! Have your plan to get to the hospital and the money and goods you need ready!</p> <p>No: ok. Where are you planning to give birth? 1. With midwife 2. Do not know</p>	<p>1: Ok it is your right, plan ahead to be safe. Talk to your midwife about what to expect from a delivery at home and make a plan with her in case of emergency.</p> <p>2: Ok. Talk to your doctor about delivery and start making a plan to be ready.</p>
Prevention	Week 15 of the life of the baby	If your baby has diarrhoea, breastfeed him more often and go to a health facility. He may be given oral rehydration solution (ORS) to prevent dehydration.		
Reminders	Week 52 of the life of the baby	After your baby is 1 year old, you will need to take her for check-ups every 2-3 months. This will keep your baby healthy. Are you planning to keep taking your baby for regular check-ups?	<p>Yes: You're taking good care of your baby! Going to the check-ups will help your baby stay healthy and Keep up the good work!</p> <p>No: Go to the check-ups to make sure your baby stays healthy. If there is something wrong, a health worker will be able to advise and help.</p>	
Baby's nutrition	Week 7 of the life of the baby	Your child needs vitamins to help her grow healthy and fight infections. Do you know how to make sure that she gets enough vitamins?	<p>Yes: Well done. Each day give your child fruit and vegetables of different colour. Try an orange, banana, tomato, and some peas.</p> <p>No: Each day give your child fruit and vegetables of different colour. Try an orange, banana, tomato, and some peas.</p>	

*Emergency public free line in Mexico for health emergencies during pregnancy and puerperium.

Appendix 3. Additional Tables and Figures

Table A1
Number and timing of messages in the main treatment

Topic	Pregnancy	Baby's first year of life	Baby's second year of life
Concerns	38	52	17
Breastfeeding	17	56	9
Development	7	32	52
Planning	11	6	2
Prevention	49	52	53
Reminders	18	28	15
Baby's nutrition		17	33
Total	140	243	181

Table A2
Number of messages in the intervention variations

Topic	Messages
<i>Main messages</i>	
Pregnancy	140
Baby	424
Total main messages	564
<i>Additional messages</i>	
T2	14
T3	25
SE T- Pregnancy and delivery	64
SE T- Baby and puerperium	71
Delivery	32
Triggers	29
Premature babies	12
Maternal emergency line reminders	6
Gratuity reminders	21
Miscarriage and stillbirth	2
Total additional messages	276

Table A.3
Respondents' selection

Variable ²	Mean	Mean if responded ¹		Difference ³
		No	Yes	
Age	27.55	27.83	28.28	-0.448
Speaks Spanish ^D	0.99	0.97	1.00	-0.026**
Can read a message ^D	0.97	0.95	0.95	0.003
Num of previous pregnancies	1.28	2.21	1.99	0.223
Risky pregnancy ^D	0.08	0.14	0.14	-0.0025
Previous risky pregnancies ^D	0.17	0.16	0.18	-0.022
Rural locality ^D	0.59	0.60	0.61	-0.0085
Clinic in the locality ^D	0.74	0.78	0.75	0.0252
Signed-up remotely ^D	0.34	0.40	0.06	0.345***
Received a mobile ^D	0.31	0.52	0.24	0.276***
Num. of observations	2851	2259	592	

¹ Mean of variables comparing characteristics of women that did not respond to the question to those that responded

² Superscript "D" indicates if the variable is a dummy

³ Difference is significant at 10% (*), 5% (**) or 1% (***)

Table A.4
Alternative outcome variables

VARIABLES	(1) Responded	(2) Responded	(3) Correct	(4) Correct
After Info ¹	-0.011 (0.0210)	-0.001 (0.0189)	0.018 (0.0212)	0.027 (0.0199)
State FE	No	Yes	No	Yes
Type of message FE	No	Yes	No	Yes
Controls ²	No	Yes	No	Yes
Observations	2,851	2,851	2,159	2,159
R-squared	0.000	0.134	0.000	0.088
Avg. before info	0.215	0.215	0.187	0.187

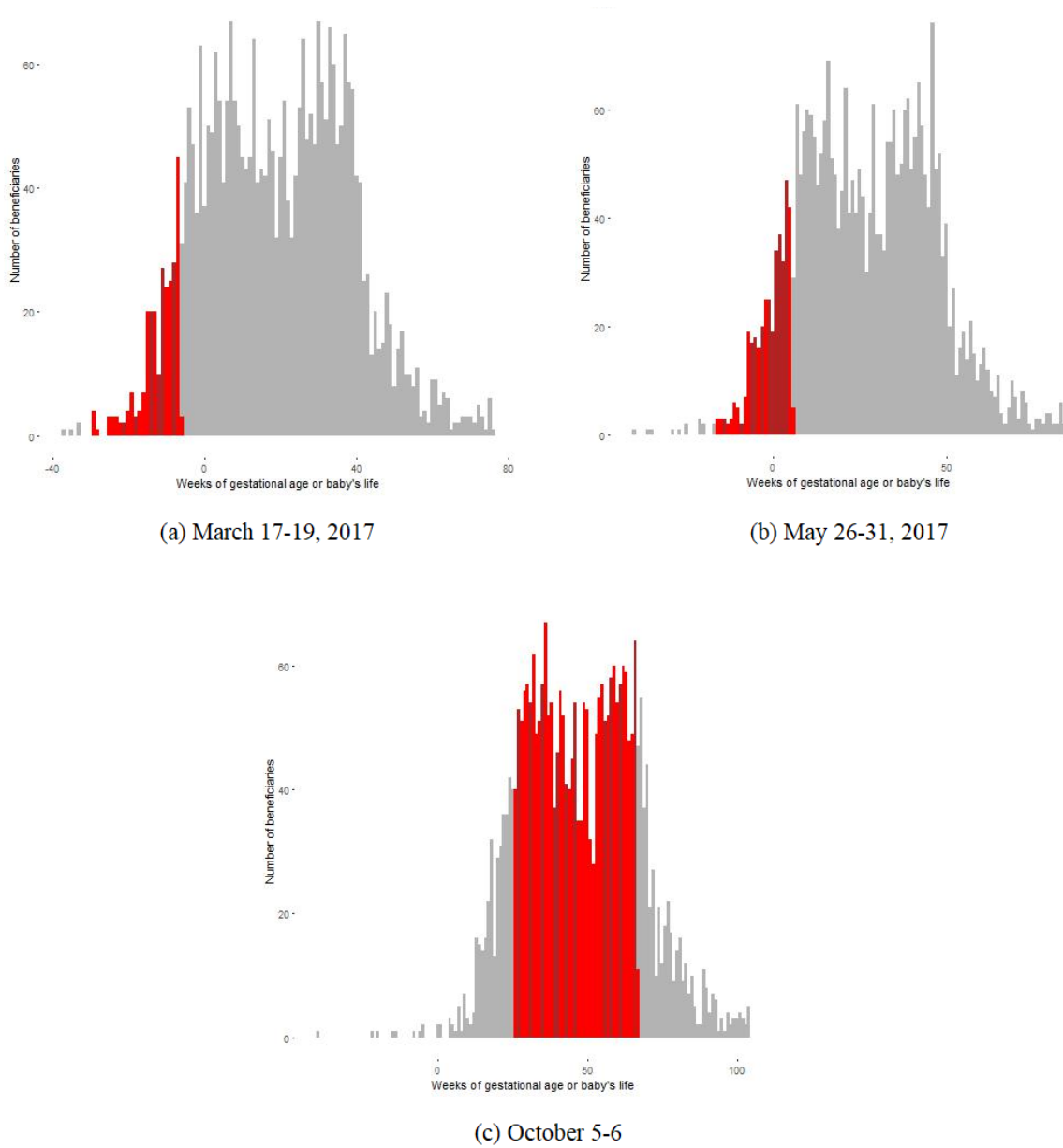
¹ Dummy equal to one if the respondent answers after the information has been received

² Controls include beneficiaries age, dummies to indicate first pregnancy, if the beneficiary received a mobile and if pregnancy is identified as risky pregnancy

Standard errors clustered by respondent in parenthesis

*** Significant at 1%, ** significant at 5%, * significant at 10%

Figure A1
Histograms of developmental age for women receiving questions



Note: The red color section corresponds to the women that were selected to receive the questions. The red bold lines correspond to the specific dates in which the PD messages containing the relevant information are sent. The gray section illustrates the women that do not receive messages.

Figure A2
Timing of messages with respect to date of birth

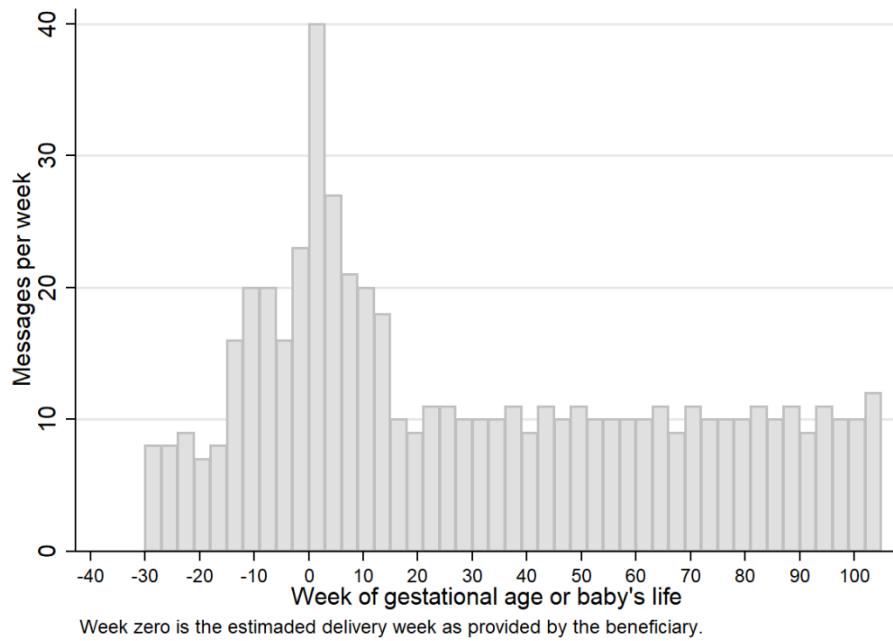


Figure A3
Histogram of the running variable

