How do Women Learn They Are Pregnant? The Introduction of Clinics and Pregnancy Awareness in Nepal

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Abstract

The earlier a woman learns about her pregnancy status, the sooner she can make decisions about her own and infant's health. This paper examines how women learn about their pregnancy status and measures how access to pregnancy tests affects earlier pregnancy knowledge. Using ten years of individual-level monthly panel data in Nepal, we find that, on average, women learn they are pregnant in their 4.6th month of pregnancy. Living approximately a mile further from a clinic offering pregnancy tests increases the time a woman knows she is pregnant by one week (5% increase) and decreases the likelihood of knowing in the first trimester by 4.5 percentage points (16% decrease). Women with prior pregnancies experience the most substantial effects of distance within the first two trimesters, while, for women experiencing their first pregnancy, distance does not affect knowledge. These results suggest that, while access to clinics can increase pregnancy awareness for women who recognize pregnancy symptoms, other complementary policies are needed to increase pregnancy awareness of women in their first pregnancy.

Keywords: Pregnancy Testing; Reproductive Health; Nepal

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1 Introduction

The knowledge of being pregnant is the first step in the continuum of care towards a healthy pregnancy or safe abortion (Boerma et al. 2018). The timing of learning about a pregnancy matters for several decisions (e.g., pregnancy termination and seeking prenatal care) and behaviors (e.g., taking multi-vitamins, stopping smoking) and may affect health outcomes for both woman and infant. While a pregnant woman will eventually learn her pregnancy status, correctly inferring this information is not trivial and depends on the knowledge of symptoms of pregnancy, prior pregnancy experiences, and access to pregnancy testing. In this paper, we examine the process through which women learn they are pregnant and how prior experience with pregnancy and access to pregnancy tests affect the timing of learning.

Even in developed countries, it is common for women to be unaware of their pregnancy status. In the United States, the average gestational age of detection is approximately 5.5 weeks, with 23% of women detecting it only after seven weeks of gestation (Branum and Ahrens 2017). In developing countries such as Nepal, awareness of one's pregnancy status may be higher than in high-income countries (Peacock et al. 2001a). Malnutrition may cause irregular periods, hiding signs that lead to pregnancy suspicion (Rowland et al. 2002). Women may have less knowledge and education about reproduction (Peacock et al. 2001b), and high rates of breastfeeding and lactational amenorrhea may lead to less awareness (Kennedy et al. 1989; Shaaban and Glasier 2008; WHO 1998).

Statistics on the timing women detect their pregnancy are still scarce in the literature. Most studies on this topic focus on women who had an abortion, and their numbers may not extrapolate to the whole population (Drey et al. 2006; Foster et al. 2008; Saavedra-Avendano et al. 2018). In a study among women getting an abortion in Europe, Ingham et al. (2008) show that the median time to suspect pregnancy is 52.5 days, and the interquartile range is equal to 21–79 days. Baum et al. (2015) report a similar wide variation among women having an abortion in Colombia. The average time of detection for abortions in the first and second trimester is 17.4 (range 0–47) and 37.1 days (range 0–84). In the United States in 2012, the average gestational age on detection has been approximately 5.5 weeks, with 23 percent of women detecting it only after seven weeks of gestation (Branum and Ahrens 2017). These statistics highlight obstacles to detecting a pregnancy (Peacock et al. 2001b). There is also uncertainty among women when they are not pregnant. A study in the United States, Zabin et al. (1996) showed that 62.4 percent of adolescents who visited a clinic to take a pregnancy test had negative results, although more than a third were quite certain they were pregnant before the result. To the best of our knowledge, only two other papers have examined the causal relationship between pregnancy test access and earlier pregnancy detection.[1] Hochman et al. (2012) show that the availability of urine pregnancy tests (UPTs) in military primary care clinics in Israel lowers the mean gestational age of pregnancy detection by 7.4 days earlier pregnancy detection. Stanback et al. (2013) find mixed results of the introduction of free pregnancy tests in family-planning clinics on the uptake of contraception in a randomized experiment in Ghana and Zambia. In more recent work, Comfort et al. (2016) show in a randomized experiment in Madagascar that when community health workers provide pregnancy tests, the uptake of hormonal contraception increases by 26 percent.

Consistent with our findings, these studies show that access to pregnancy tests decreases pregnancy detection time and increases health services' take-up. However, our paper is the first to show that the distance to clinics offering tests is itself a constraint to pregnancy detection. Our results can be extrapolated to similar settings and offer different policy conclusions from the previous studies.

This paper is organized as follows: Section 2 presents the research design: the setting of our study, the data, and the sample used in the analysis. Section 3 describes the empirical approach to estimate the effect of distance to clinics with pregnancy tests on pregnancy knowledge. Section 4 presents the results, including the effect of distance pregnancy awareness overall and by trimester. Section 5 concludes.

[1] A vast literature describes how access to pregnancy tests can increase the uptake of services. In our setting, Andersen et al. (2013) show that female community health volunteers in Nepal can use the result of UPTs to refer women to the appropriate services (antenatal care/abortion or contraceptive methods).

2 Research design

In this section, we describe the setting, the main datasets and variables, and how the analytical sample was selected for our study.

2.1 Setting: Chitwan, Nepal, 1997 to 2006

The data used in this study were collected between 1997 and 2006 in the western valley of Chitwan District in south-central Nepal. During this time, Nepal, particularly Chitwan, went through many changes regarding its economic and political development, access to reproductive health care, and fertility.

Until 1950, Chitwan was mainly uninhabited. In the late 1970s and 1980s, the region received infrastructure projects that connected it to the rest of the country and India (Axinn and Yabiku 2001). As a result, the population grew, the area developed, and more services became available: the first medical provider opened in the area in 1954 (Brauner-Otto et al. 2007), and by 1990 there were more than 80 clinics in the region (Yabiku 2004).

From 1996 to 2006, Nepal faced an armed conflict between the government and the Communist Party of Nepal (Maoist). The study area was not affected by this conflict until around 2000. From then until 2006, daily activities were affected by bomb blasts, gun battles, and conflict-related fatalities. We describe the effect of the civil conflict on our data and empirical strategy below.

The use of family planning and maternity care services also changed in Nepal during this time. In 2001, the earliest year this information is available, 9.8% of women in the country delivered in a health clinic, while 18.8% did so in 2006 and 62.3% in 2016; similarly, only 16.4% of pregnant women received ANC care prior to the fourth month of pregnancy in 2001, compared to 27.7% in 2006, and 65.1% in 2016 (ICF 2019).

The patterns of fertility also changed during this period. The total fertility rate plummeted, falling from 4.6 births per woman in 1996 to 3.0 in 2006 and 1.9 in 2019. The ideal number of children for married women fell from 2.9 in 1996 to 2.4 in 2006 and 2.1 in 2016. A remarkable improvement was the drop in the maternal mortality ratio. Nepal had one of the world's highest ratios in 1996 (631 per 100,000 live births), which dropped to 425 in 2006 and 186 in 2017 (WHO and the United Nations Population Division 2019).

In addition, abortion was legalized 2002 if performed within the first twelve weeks of pregnancy, with some exceptions (Thapa 2004). Despite the legalization, in 2011, almost a decade after the law, less than 38% of Nepali women believed abortion was legal (ICF 2019).[2]

2.2 Data

The data used in this study comes from the CVFS (Axinn 2019). A sample of 1,582 households (4,646 individuals) in 151 neighborhoods was selected to participate in the study in 1997. Each neighborhood consisted of 5 to 15 households surrounded by farmland. The study area includes three sampling strata corresponding to three areas with different degrees of urbanization.

From 1997 to 2006, enumerators regularly visited each household to record any major changes in the household's structure, such as pregnancies, births, marriages, divorces, and living arrangements. All residents of the sampled neighborhoods between the ages of 15 and 59 and their spouses were surveyed. These data also contain a record of the neighborhood where each member of the household was living, and members were followed if they migrated. Households that moved into the CVFS area during the study were also surveyed while living there.

In addition to collecting general household information each month, the study team collected data directly from each woman of reproductive age (18–49) about her pregnancy status and any pregnancy-related events such as miscarriages, abortions, stillbirths, or live births. This individual-level monthly panel data measuring the reproductive behavior of married women in Nepal is our main data source (Axinn et al. 2018).

[2] Recently, abortions have been increasing, especially in more developed areas (ranging from 21 to 59 per 1,000 women aged 15–49) (Puri et al. 2016). The estimate of illegal abortions—by definition, performed after 12 weeks of pregnancy—however, is still high: 58% of the abortions performed in 2014 were estimated to be illegal.

The data are monthly, but the frequency of enumeration changed over time, as shown in Table 1. Between 1997 and 1999, households were interviewed approximately ten times per year. Between 2000 and 2005, survey budget constraints and civil conflict resulted in several changes to the data collection process. Surveys were conducted only during daylight, and the frequency of household visits was reduced, so the total number of visits per year ranged from six visits in 2000 to only one visit in 2003 (Axinn et al. 2012).

2.3 Variable Construction

We have two main variables in our analysis: women's pregnancy knowledge and distance to clinics offering pregnancy tests.

To construct a pregnancy knowledge variable, we start by determining a woman's pregnancy status using the monthly survey data. We observe the following possible status: not pregnant, pregnant, uncertain, had a live birth, stillbirth, miscarriage, or abortion. Appendix Table 1 shows the distribution of pregnancy statuses over the months when women were interviewed. We exclude from our sample pregnancies that did not end in live birth because we cannot infer their gestational months.

For any month in which a woman reports a live birth, we code each of the prior nine months (including when the birth was reported) as that the woman is pregnant. Although some variation of gestation duration exists among women, the nine-month duration is estimated based on the calculation of average delivery dates (280 days after the beginning of the last menstrual period, or 9.2 months) (Jukic et al. 2013).[3] A woman's pregnancy knowledge is the result of contrasting her contemporaneous pregnancy report with this constructed status based on the month of birth.

Our measure is not the exact date of pregnancy detection, and its construction may have some measurement errors; nevertheless, even if women were to misreport their pregnancy status, as long as the distance to a clinic is not systematically correlated with time to reveal the pregnancy status, our

[3] Our definition of the reported month of pregnancy implicitly assumes that the month a woman reports she is pregnant coincides with the month she detects it. This fact is not necessarily true in all contexts; for example, qualitative studies in developed countries find that women may conceal their pregnancy until birth

estimates of the effect of distance to clinics on pregnancy awareness will not be biased. In addition, since women are asked about their status in the month of the interview, our measure is less susceptible to recall error biases.

To construct the distance to clinics with pregnancy tests, we use neighborhood-level information detailing all health service providers in the CVFS area from 1997 to 2005, collected in the CVFS (Axinn et al. 2018). The data contain each provider's geographical location, its year of opening and closure, and information on infrastructure, personnel, and services. It includes separate availability of family planning and pregnancy test kits.

The distance from a respondent's home to a health provider is measured by the geodesic distance between the centroid of a household's neighborhood and the clinic's exact location. We calculate the minimum distance to a clinic offering pregnancy tests and to a clinic offering family planning services for each household. We then create a binary variable equal to one if the woman lives in a neighborhood where the distance to the closest clinic is above the median distance and zero otherwise. The median distance is calculated based on the distance assigned to each woman-month observation during all our sample period. It is a constant threshold equal to 0.92 miles (1.48 km) and does not vary across time in our analysis. We assume the shortest distance to a clinic for the entire pregnancy if the distance changes because the woman moved or a clinic opened or closed during her pregnancy.[4]

or until a certain stage of gestation (Peacock et al. 2001a; Stokes et al. 2008). Because the survey in our study was administered in privacy by female interviewers, and the interviews occurred frequently over time to build rapport with respondents, women may have felt comfortable answering truthfully (Axinn 2019).

[4]Part of the women who move during pregnancy stay in the study region (54 pregnancies, or 3.08%), and the remaining move out of the study area (242 pregnancies, or 13.82%). For women living outside of the study area, we do not know the distance to health providers in their vicinity. We discuss more details in Section 2.4.

Table 2 presents the number and characteristics of health providers offering family planning services or pregnancy tests from 1997 to 2005 in the CVFS study area. Out of 94 health clinics in the area in 1997, 82 provided modern family planning, and 24 offered pregnancy tests. From 1997, the number of providers offering pregnancy tests grew to a total of 103 in 2005. The distance to the closest provider declines significantly over time, from 1.13 miles, on average, in 1997, to 0.48, in 2005. The median distance from a neighborhood to a pregnancy-testing clinic is 0.92 miles.

2.4 Analytical Sample: Women Who Ever Had a Live Birth

Our sample includes married women who had a live birth during our study period, who were directly interviewed by an enumerator during gestation, and for whom we know the distance to a clinic.

Because we only have information about clinics in the CVFS area, we restrict our sample to women who lived in the CVFS area (i.e., one of the 151 neighborhoods) for at least one month during her pregnancy. Since the clinic data covers only 1997-2005, we include 2006 births only if the pregnancy started in 2005. We only consider months when the woman was interviewed about her pregnancy status directly by enumerators. We analyze 1,593 recorded live between 1997 and 2006.

Table 1 presents the total sample of women, ranging from 3,033 women in 1997 to 3,528 in 2006. Panel A reports the average number of times a woman was interviewed each year, which varies from almost ten times a year in the first year of the study to approximately two times in 2006. On average, 3356 women were interviewed 5.5 times each year; in 2004, when the civil conflict was at its peak, the average number of interviews reached a low of 1.20 times per year. Appendix Table 2 shows how the sample composition changed over the ten years of the study, indicating how many women leave and join the survey each year.

Table 1, Panel B, shows the average observed pregnancy status over time by women. Across all years, we observe, on average, the reported pregnancy status of 2,496 women (74% of the total sample of women interviewed). It varies from 94% in 1998, the second year of the survey, to 9% in 2004, during the peak of the conflict discussed in Section 2. From these women, on average, 254.7 of the women interviewed (8%) report a live birth in a year.

Panel B shows how the sample size changes when we apply the necessary exclusion restrictions for our analysis: considering only women who were directly interviewed by an enumerator in that year, who had a live birth, and who lived in CVFS for at least part of her pregnancy so that we can assign her a distance to a clinic.

3 Empirical Strategy

This section presents the two main estimation approaches to understand the effects of access to pregnancy tests on pregnancy status knowledge. To measure how access to pregnancy tests impact the time women detect their pregnancy, we explore changes in households' distance to health centers offering such tests after controlling for place, time, and access to family planning services. We measure the effect of distance with a binary variable that is equal to one if a woman lives farther than 0.92 miles from a clinic offering pregnancy tests and zero otherwise. This distance corresponds to the median distance to a pregnancy-testing clinic in our sample. The advantage of having a binary variable of distance is that it allows our model to capture non-linear effects of distance on pregnancy awareness. In Appendix Table 3, we show that our results are similar using a continuous measure of distance to a pregnancy-testing clinic.

First, we measure the effect of distance to pregnancy tests on overall pregnancy awareness, where each observation is a pregnancy, and the main outcome is the month a woman learned about her pregnancy. Second, we measure the effect of distance to pregnancy tests on pregnancy awareness by trimester; in this case, each observation is a month of pregnancy when a woman was interviewed. We run three separate regressions, one for each trimester, where the main outcome is if a woman is aware of her pregnancy in that trimester.

To understand the mechanisms driving our results, we estimate these two models by women's experience with prior pregnancies. Women who had pregnancies in the past likely differ from women in their first pregnancy in several aspects, including in recognizing the signs and symptoms of pregnancy.

3.1 Overall Pregnancy Awareness

Our first approach is to estimate the following using observations at the woman-pregnancy level:

[redacted] (1)

$ReportPreg_{iph}$ indicates the month of gestation when a woman *i* during pregnancy *p* and living at a neighborhood *h* reports she was pregnant; this number ranges from 1 to 9. $DistPT_{iph}$ equals one if neighborhood *h* is located above the median distance to a clinic with pregnancy tests and zero otherwise. In Appendix Table 3, we show that our results are robust to using a continuous measure of distance.

To isolate the effect of distance to pregnancy tests on pregnancy awareness, we consider access to family planning methods as a potential confounder. The literature shows that proximity to women's health clinics affects the take-up of services, such as preventive care, and contributes to a decline in fertility rates (Lu and Slusky 2016; Rossin-Slater 2013; Bailey 2012). Therefore, access to contraception could itself affect women's awareness by decreasing the risk of being pregnant and affect our main estimates due to omitted-variable bias. We specifically control for the distance to family-planning clinics with $DistFP_{iph}$, which is an imperfect measure of access to family planning methods. It equals one if the woman lives in a neighborhood where the distance to the closest clinic offering contraceptive methods is above the median distance and zero otherwise.[4]

We add age fixed effects, θ_{iph}, since awareness of pregnancy may vary with sexual activity and experience, which are correlated with age. We consider age in the first month of pregnancy. [5]

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[4] We obtain similar results when controlling for an indicator variable of the woman using contraception within six months of becoming pregnant.

[5] Ideally, we would control for other individual characteristics, such as education, wealth, and labor force participation. However, the high-frequency dataset we use focuses on family planning variables. Other socioeconomic variables are available for a small share of women who were in the sample in 1997. We show in a robustness check in Appendix Table 4 that our main results are robust to controlling for

We control for the number of times during pregnancy a woman was interviewed with fixed effects η_{iph}. Therefore, η_{iph} controls for any effect the frequency of interviews may have had on pregnancy awareness; it also indirectly controls for other omitted variables correlated with pregnancy awareness and frequency of interviews. Our estimations consider only how variations in the distance to pregnancy-testing clinics affect women interviewed the same number of times during pregnancy after controlling for strata-year and age fixed effects. In Appendix Table 5, we show that our results are robust to omitting this control.

We include strata-by-year fixed effects, γ_{iph}, to account for possible changes specific to an area over time that could be correlated with pregnancy awareness or access to clinics. These fixed effects control for annual changes in a strata's infrastructure—such as the improved roads and opening of new schools—and demographic aspects—such as changes in the typical family size and age of first birth. In Appendix Table 6, we include instead strata-by-year-by-season fixed effects, which accounts for common changes in strata, year, and season. We split the seasons between rainy (June to September) and other months. This control accounts even more flexibly for strata-specific variations in conditions during the year that could be correlated with both pregnancy awareness and distance to a clinic.[6]

The main identifying assumption to estimate the effect of distance to clinics with pregnancy tests on pregnancy awareness is that, after controlling flexibly for a woman's age, the number of times she is interviewed during her pregnancy, unobservable characteristics of the location where she lives that may vary across years, and distance to family-planning services, the distance to a clinic offering pregnancy tests is exogenous. A threat to validity is if, after controlling for the variables mentioned above, other unobservable factors that affect pregnancy awareness vary systematically with the

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years of education and years of marriage. However, we do not add these controls in our main estimates because our sample is reduced from 1,593 to 801 woman-pregnancy observations.

[6] The strata-year-season fixed effects control for important variations in distance to a clinic and pregnancy awareness. For example, suppose a woman interviewed once during her pregnancy who lives in an area with difficult access during the rainy season. Before evaluating how the distance to a clinic affects pregnancy awareness, the model accounts for the average pregnancy awareness of women living in that strata during that rainy season. In addition, we compare this woman with others interviewed the same number of times. Even if there are unobserved factors correlated with the road conditions that affected conception months earlier, as long as they are common to pregnant women in this strata and year-season, our estimates control these effects.

distance to clinics with pregnancy tests. For example, the opening of new roads, or new schools, could be positively correlated with clinics' location decisions and the location where more educated households decide to live. If a woman living in such households is more likely to be aware of her pregnancy status, and if our strata-year fixed effects do not capture such changes, it can bias our estimates.

3.2 Pregnancy Awareness by Trimester

To capture the effect of distance to clinics with pregnancy tests on pregnancy awareness by trimester, we estimate a model similar to Equation 1, but at the woman-month level. For each trimester, we estimate the following model:

[redacted]

where $ReportTrimester_{imph}$ is a binary variable equal to one if a woman *i* during month *m* of pregnancy *p* living in neighborhood *h* reported being pregnant. We estimate Equation 2 separately for each trimester, and in each estimation, we restrict our sample to women interviewed during that trimester.

This dependent variable is equal to one if the woman was aware of her pregnancy during that trimester. For example, suppose a woman was interviewed during the first and last trimester of pregnancy and detected her pregnancy in the second trimester. This woman would be part of the models estimating the effects of pregnancy on the first and third trimesters. She enters the third-trimester model as knowing about her pregnancy; we do not worry about when she detected it, only if she was aware of it in that trimester.

$DistPT_{imph}$ is a measure of distance as defined above, but in this case, allowed to vary by month of pregnancy. The distance between a household and a clinic varies by year, except for the conditions described in Section 2.3. However, a woman's pregnancy may span over more than one calendar year, which means the distance to the closest pregnancy-testing clinic may vary across months of pregnancy. In Equation 1, estimated at the woman-pregnancy level, we assume the minimum distance if the distance varies during gestation. In Equation 2, estimated at the woman-month level, we can follow a more flexible approach and allow the distance to change by month within a trimester.[7] θ_{imph} are age fixed effects. ρ_{imph} are month-of-pregnancy fixed effects, which account for the month of pregnancy when the woman was interviewed. We control for the month of the interview because a woman is more likely to know and report her pregnancy as it advances. γ_{iph} are strata-by-year fixed effects, as in Equation 1.

We cluster the standard errors of all estimations in equations 1 and 2 at the neighborhood level since this is the source of variation in the distance to the nearest health center.

4 Effect of Distance to Clinics with Pregnancy Tests

This section presents the estimated impact of distance to clinics with pregnancy tests on pregnancy awareness. In our sample, women detect their pregnancy at 4.6 months, on average. There is a wide variation in the time of pregnancy detection; the median time is four months, and the interquartile range is equal to three–six months. Late detection is a common occurrence in our setting: on average, 72% of women interviewed in the third month of their pregnancy are still not aware of their status.

We present two sets of results to understand how access to clinics with pregnancy tests affects pregnancy awareness in this context. First, we show the effect of distance on the whole pregnancy, measured at the woman-pregnancy level. Second, because the estimate may mask important heterogeneity across pregnancy terms (i.e., first, second, or third trimester), we show the effect of distance by trimesters, measured at the woman-month level. For the same reason, we present all results separately by women's prior experience with pregnancy.

[7] Still, only 2.5 percent of woman-month observations record a change in the minimum distance to a pregnancy-testing clinic within a trimester. For example, suppose a woman had the first month of pregnancy in December 1997, and a new clinic offering pregnancy tests opens near her house in 1998. If the woman was interviewed in each of the first three months of her pregnancy, she would enter the estimation of awareness in the first trimester, specified in Equation 2, three times (and each time, the indicator of pregnancy awareness would reflect her awareness by month). However, her distance to a pregnancy-testing clinic will be larger in the first month of the first trimester than in the other two.

4.1 Effect of Access to Pregnancy Tests on Overall Pregnancy Awareness

Table 3 presents the estimates from Equation 1, showing the effects of distance to a clinic with pregnancy tests on the month a woman learned she was pregnant, controlling for the distance to a clinic with family planning, the woman's age, the number of times she was interviewed during pregnancy, and strata-by-year unobservable and constant characteristics.

We find a strong negative relationship between distance to clinics with pregnancy tests on earlier pregnancy knowledge. In Column 1, we see that going from below to above the median distance to access pregnancy tests increases by 0.23 months the time women report their pregnancy, or by 5%. This result implies that living farther than 0.92 miles (approximately 15 minutes walking) from a clinic offering pregnancy tests increases the time a woman knows she is pregnant by approximately one week.

In columns 2 and 3 of Table 3, we consider how the effect of distance to pregnancy tests on pregnancy knowledge varies with prior experience with pregnancy. The estimates show that the overall effect in Column 1 is driven by women who have previous experiences with pregnancy. Moving from below to above the median of distance to clinics with pregnancy tests increases the month women with prior pregnancies report being pregnant by 0.52, or 11.2%. The effect is not significant for women in their first pregnancy. In Appendix Table 3, we show that our results are robust to a continuous measure of distance to a clinic with pregnancy tests.[8]

The results in Table 3 show that distance to clinics offering pregnancy tests is only a constraint to pregnancy awareness for women who have had previous pregnancies. We interpret this result as evidence that women with prior pregnancies can recognize the signs of pregnancy and be motivated to visit a clinic earlier to confirm it if the clinic is close to their homes. Our results also show that pregnancy awareness of women in their first pregnancy is not affected by distance to a clinic. We

[8] Appendix Table 3 shows the results when the distance to a clinic with pregnancy tests is defined as the logarithm of the distance in miles, controlling for the logarithm of the distance to a clinic offering family planning services. The effect is still positive but not significant for all women and positive and significant for women with prior pregnancies.

interpret this finding as evidence that these women do not recognize the symptoms of pregnancy and decide to wait even if they live close to a clinic.[9]

Although we cannot determine why only women with prior pregnancies living close to a clinic visit it earlier, potential reasons include confirming the pregnancy to prepare for another child or have an abortion (Puri et al. 2016; Simkhada et al. 2008). Sex preference and selective abortion can also be a motive to visit a clinic, although, at the time and setting of our study, access to the technology to determine the sex of the fetus was likely rare (Kozuki et al. 2016; Frost et al. 2013).

We do not measure the effect of access within women because most women have only one live birth in our period of analysis (65%), regardless of their prior pregnancy experience. However, our results are very similar when considering only the first birth of women in the sample. By considering women with more than one birth during our study period, we have a larger share of women who have previous experience with some prenatal care and birth in the CVFS study area during our sample period. If these women are less constrained by the distance to a pregnancy-testing clinic, we would expect their inclusion in our models to drive our estimates towards zero (for example, if they know the providers in a clinic and are not much affected by the distance to it). Appendix Table 7 supports this mechanism and shows larger point estimates of the effect of distance of pregnancy awareness when we restrict the sample to women with no prior pregnancy experience in the CVFS study area during our sample period.

Because our measure of distance to pregnancy test clinics could be capturing other characteristics of health providers—for example, access to prenatal care—we estimate placebo models with distance to other types of clinics. Appendix Table 8 shows the results of replacing the indicator of the distance to a pregnancy testing clinic with indicators of distance to any clinic, distance to a government clinic,

[9] Our summary statistics show that women in their first pregnancy, regardless of where they live, visit a clinic later in pregnancy than women with prior pregnancies living closer to a clinic. Women in the first pregnancy living above the median distance to a pregnancy-testing clinic detect their pregnancy at 4.21 months, and women living below the median distance, at 4.22 months, on average. However, women with prior pregnancies detect their pregnancy at 4.40 months if they live far from a clinic and at 4.17 months if they live closer to a clinic.

and distance to a clinic offering prenatal care. We find no effect of these distances on pregnancy awareness.

The placebo test supports our main results that, after controlling for the distance to clinics offering family planning, women's age, and strata-specific trends, our estimation is evidence that the offer of pregnancy tests that matter for pregnancy awareness. An important caveat is that we cannot specify what affects pregnancy awareness: the use of pregnancy tests or other characteristics common to clinics that offer such tests (for example, providers with more knowledge of pregnancy symptoms or information campaigns about pregnancy detection). Moreover, our placebo test does not test for other means of access to pregnancy tests—for example, through community health workers (Andersen et al. 2013). These services are other means of accessing pregnancy tests. Their presence may drive our point estimates toward zero; however, these services were not common during our sample period (less than two percent of clinics have female village health workers or female family planning workers). Nevertheless, our results support the findings that shortening distance to pregnancy tests increases pregnancy awareness and can have a positive impact on women's health (Morroni and Moodley 2006; Puri et al. 2014).

4.2 Effect of Access to Pregnancy Tests on Pregnancy Awareness by Trimester

We now look for differences in the effect of access to pregnancy tests on pregnancy awareness by trimester of pregnancy. We care about the effect by trimester for two reasons: we expect women to be more likely to report a pregnancy as gestation advances, and the health benefits of detecting a pregnancy earlier are larger.

Table 4 shows the effect of distance to clinics with pregnancy tests on the probability of reporting a pregnancy in each trimester. If access to pregnancy matters, we expect the coefficient to be negative, which is the opposite of what we expected in Table 3—where the outcome was the month the pregnancy was reported.

Column 1 of Table 4 shows that moving above the median distance to clinics with pregnancy tests decreases by 4.5 percentage points the probability a woman knows she is pregnant in the first trimester. This reduction corresponds to a 16.1% decrease in the percentage of women who know their pregnancy status in the first trimester (28%).

In columns 2 and 3, we explore potential heterogeneities in this effect by women's previous experience with pregnancies. The results follow the pattern we found in the overall pregnancy results in Table 3: the distance to clinics offering pregnancy tests is a binding constraint only to women who have had previous pregnancies. Column 2 of Table 4 shows that living above the median distance to clinics with pregnancy tests decreases the probability women with prior pregnancies know they are pregnant in the first trimester by 6.2 percentage points—a decrease of 25.2% from the mean. Column 3 shows that the effect is not significant for women in their first pregnancy.

Columns 4–6 and 7–9 show the effect of distance to clinics with pregnancy tests on knowledge in the second and third trimester. The effect of distance on all women and women with prior pregnancies is larger in the second trimester; it represents a decrease in the probability of knowing about pregnancy in the second trimester of 6.5 percentage points (or 8.5%) for all women and 12.4 percentage points (or 16.8%) for women with prior pregnancies.

In the third trimester, the effect of distance to clinics with pregnancy tests is negative but not significant for all women, and negative but smaller than in other trimesters for women with prior pregnancies—equal to a decrease of 2.5 percentage points in the probability of knowing she is pregnant (or 2.5%).

The results in Table 4 lead to two main conclusions. First, it supports the findings in Table 3 that the distance to clinics with pregnancy tests does not affect women in their first pregnancy. Thus, the effects of distance in all trimesters are statistically insignificant for these women (with wide confidence intervals). Second, it shows that the distance constraint binds the most for women in earlier pregnancy months. In the last trimester of pregnancy, the need to access a clinic to confirm a pregnancy is smaller since other pregnancy signs are more evident.

5 Conclusion

In this paper, we provide new evidence on when women learn about their pregnancy status and how access (distance) to pregnancy tests affects the timing of learning. We use a novel high-frequency dataset over ten years in Nepal, where women are asked monthly about their pregnancy status. These unique data allow us to measure pregnancy awareness more accurately than with retrospective reports. We also measure changes in access to pregnancy tests over ten years of data as new clinics open or existing clinics begin stocking pregnancy tests, separately controlling for clinics offering family planning to account for possible confounding factors related to distance to clinics.

We find that women who live farther from a clinic with pregnancy tests report their status later in pregnancy. By increasing the distance to a health center with pregnancy tests from less to more than 0.92 miles (median distance), women increase by approximately one week the time they report their pregnancy. The likelihood of knowing their pregnancy status in the first trimester also decreases by 4.5 percentage points, or by 16.1%. These effects differ by a woman's previous experience with pregnancies and by trimester; the distance constraint is binding the most for women with previous pregnancies.

For women who had a prior pregnancy, the impact of distance on the probability of reporting pregnancy is negative and significant in all trimesters. Moving above the median distance to a clinic with pregnancy tests decreases the probability of reporting a pregnancy in the first, second, and third trimesters by 6.2, 12.4, and 2.5 percentage points. This result suggests that experience with pregnancy symptoms may be important to utilize clinics with pregnancy tests in earlier months. Among women with no prior pregnancies, the effect of distance on pregnancy knowledge is not significant during any trimester or overall during pregnancy. These results suggest that access to pregnancy tests is a binding constraint only after women's awareness of signs of pregnancy is strong enough to motivate a woman to confirm her pregnancy.

The policy implication of our study is that understanding the process of how a woman learns of her pregnancy status can help health providers design policies or provide access to pregnancy tests that could result in healthier infants and mothers. Women can use the knowledge of their pregnancy status to optimize their behavior, such as beginning antenatal care (Simkhada et al. 2008) or having an abortion (Drey et al. 2006). Pregnancy knowledge is important for women to receive early antenatal care, which is correlated with healthy pregnancy outcomes (Hueston et al. 2003; Ratzon et al. 2011). In developing countries, only half (48%) of women receive early antenatal care (Moller et al. 2017); earlier pregnancy detection may not only help women seek earlier care (Morroni and Moodley 2006; Lamina 2013) but also help them adopt healthy prenatal behaviors. Earlier pregnancy detection also enables women to begin making plans for delivery and motherhood or to make earlier decisions about abortion, which are associated with lower rates of complications and mortality (Grossman et al. 2008; Henderson et al. 2013; Puri 2020).

Our study covers a period of high maternal mortality in Nepal, which is still an important issue in many other countries. Our results show that access to clinics with pregnancy tests is an important constraint for pregnancy awareness. Since pregnancy testing is a relatively inexpensive technology, improving its availability has the potential to affect pregnancy knowledge, and in the end, to improve the woman and the infant's conditions during gestation and beyond.

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TABLE 1 Sample of Women by Year

	Year									
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Panel a: married female respondents										
Sample	3033	3296	3278	3364	3402	3558	3590	3024	3486	3528
Times interviewed per year (avg)	9.76	8.67	10.05	9.23	5.84	3.11	3.04	1.2	2.41	2.18
Panel b: observed pregnancy status										
Observed pregnancy status	2630	3096	2683	2642	2681	2826	2891	267	2597	2646
Had a live birth	220	323	345	268	286	288	252	191	191	183
Living in CVFS during pregnancy	183	227	224	184	215	223	207	91	111	85
Observed month of pregnancy detection	181	216	223	179	202	190	170	54	103	75

Notes: This table shows the total sample of married female respondents in the data, in panel A, and the sample used in our analysis, in panel B. The third row in panel B corresponds to our main sample of women when the outcome is knowledge by trimester. The last row in panel B corresponds to our main sample of 1,593 woman-pregnancies when the outcome is month of detection. The small difference between these two last rows corresponds to women who were interviewed at some point during pregnancy when they did not know their status, but were not interviewed again; therefore they cannot be part of the sample when the outcome is month of pregnancy detection.

TABLE 2 Sample of Health Providers by Neighborhood and Year in the Study Area

	Year								
	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total clinics	94	96	106	108	113	128	133	142	168
Total clinics with pregnancy tests (PT)	24	27	34	34	43	59	66	78	103
Distance to PT clinics (miles)	1.128	1.093	1.006	1.016	0.865	0.739	0.711	0.583	0.478
Total clinics with family planning (FP)	82	84	93	95	102	117	119	129	154
Distance to FP clinics (Miles)	0.599	0.625	0.623	0.624	0.585	0.532	0.505	0.49	0.44
Correlation distance to FP and PT clinics	0.496	0.481	0.538	0.532	0.571	0.652	0.659	0.915	0.942

Notes: This table shows the total number of any type of health provider, the total number of health providers offering pregnancy tests, and the total number offering family planning services in the CVFS study area. The distance is the average distance from a clinic to the centroid of neighborhoods in our sample. The health provider data for 2006 is not available.

TABLE 3 Impact of Distance to Clinic with Pregnancy Tests on Overall Pregnancy Knowledge

	Month reported pregnancy		
	All women	Prior pregnancies	No prior pregnancies
	(1)	(2)	(3)
Distance to pregnancy tests	0.227**	0.515***	-0.184
	(0.112)	(0.177)	(0.329)
Distance to family planning	0.074	-0.149	0.482
	(0.117)	(0.194)	(0.315)
Observations	1,593	636	308
Adjusted R-squared	0.112	0.148	0.106
Mean dependent var.	4.591	4.613	4.617

Notes: This table shows the result of three separate regressions. All columns include strata-year fixed effects, number-of-interviews-during-pregnancy fixed effects, and age fixed effects. We have information of prior pregnancies for 944 woman-pregnancy observations, therefore the sample size in columns 2 and 3 do not add up to the total in column 1. Standard errors are clustered at the neighborhood level.

TABLE 4 Impact of Distance to Clinic with Pregnancy Tests on Pregnancy Knowledge by Trimester

	Knew in first trimester			Knew in second trimester			Knew in third trimester		
	All women	Prior pregnancies	No prior pregnancies	All women	Prior pregnancies	No prior pregnancies	All women	Prior pregnancies	No prior pregnancies
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance to pregnancy tests	-0.045**	-0.062**	0.015	-0.065**	-0.124***	-0.002	-0.005	-0.025**	0.033
	(0.020)	(0.030)	(0.059)	(0.028)	(0.042)	(0.058)	(0.009)	(0.012)	(0.026)
Distance to family planning	-0.039*	-0.034	-0.100*	0.014	0.044	-0.060	0.013	0.007	0.010
	(0.021)	(0.032)	(0.059)	(0.027)	(0.044)	(0.054)	(0.008)	(0.011)	(0.025)
Observations	2,792	1,324	557	2,732	1,305	537	2,632	1,280	511
Adjusted R-squared	0.146	0.145	0.207	0.089	0.106	0.163	0.027	0.048	0.052
Mean dependent var.	0.280	0.246	0.266	0.769	0.736	0.769	0.974	0.976	0.967

Notes: This table shows the result of nine separate regressions. All columns include strata-year fixed effects, month-of-interview fixed effects, and age fixed effects. Standard errors are clustered at the neighborhood level. We have information of prior pregnancies for a smaller share of woman-month pairs, which affects the sample size in the results splitting women by their experience with prior pregnancies. Each column is conditional on the woman being interviewed in that trimester. Standard errors are clustered at the neighborhood level.