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Prenatal care utilization in Zimbabwe: Examining the role of community-level factors

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1. Introduction

Despite notable improvements in prenatal care use over the past two decades [1], poor maternal and child health outcomes continue to be serious challenges in Sub-Saharan Africa (SSA). For instance, while the proportion of pregnant women receiving prenatal care from a skilled health professional rose from 69% in 2006 to 77% in 2013, maternal mortality remained high around 520 deaths per 100,000 live births representing more than 50% of the reported global maternal deaths [2]. Important progress has also been made regarding infant and under-five mortality. For instance, though still unacceptably high, the infant (under-five) mortality rate dropped from 108 (180) deaths per 1000 live births in 1990 to 56 (83) deaths per 1000 live births in 2015 respectively [3].

Numerous studies have linked timely, adequate and high-quality prenatal care use to better maternal and newborn health outcomes [4–7]. Adequate and timely sought prenatal care offers numerous benefits to pregnant women from early detection of complications to nutritional intake advice, behavioral education and preparation for motherhood [8,9]. Most developing countries in Asia and SSA including Zimbabwe follow the four-visit model as recommended by the World Health Organization (WHO) for women with less complicated pregnancies and living in low-income regions [9].

Empirical research on the determinants of prenatal care in SSA and Asia is vast and rapidly growing. This research has established that individual and sociodemographic factors are important predictors of prenatal care use. These factors include but not limited to maternal education, cultural or religious beliefs, maternal employment status, location, and pregnancy desire (i.e. whether the woman wanted the pregnancy at the time she got pregnant) [10–13]. However, little is known about the contribution or influence of community-level factors on the use of antenatal care services in countries with poor maternal and child outcomes such as Zimbabwe.

Building on the above literature, the primary objective of this study is to examine the overall importance of the community-level factors such as religious composition, contraceptive prevalence, density of nurses, hospitals, and health expenditures at the cluster-level on the timing of care, frequency of visits and quality of received prenatal care. Religious beliefs at the community-level are believed to play an essential role in shaping women’s attitudes and behavior towards the use of maternal care services [14,15]. Social ties within communities also help influence contraceptive utilization rates [14]. Thus, an understanding of the contribution of community-level factors is imperative for public policy in the design of relevant public health policies. The focus on community factors is prompted by the fact that individuals constitute the
communities, their behavior and beliefs are in turn shaped by the same communities in which they reside [16].

The analysis uses two rounds of the nationally representative Zimbabwe Demographic and Health Survey (ZDHS) to test the influence of community-level factors on the utilization of antenatal care services in Zimbabwe. Zimbabwe is a particularly interesting case to consider for two reasons. First, high prenatal care utilization rates continue to co-exist with unfavorable pregnancy outcomes like high under-five mortality rates [17]. According to the ZDHS, approximately 92% of pregnant women received some form of prenatal care between 2000 and 2011, and yet the average maternal mortality rate stood at 960 deaths per 100,000 live births over the same period. Furthermore, recent official statistics on child mortality reveal that the infant (under-five) mortality increased from 53(77) deaths per 1000 live births in 1990–1994 to 57(84) deaths per 1000 live births in 2010–2011 [18].

Second, a cursory examination of the data reveals that most pregnant women still initiate prenatal care well after the first three months and have inadequate and low quality prenatal care. The ability to provide quality prenatal care services in the country is often lacking due to serious deficiencies in skilled health providers, senior medical staff, functioning laboratory equipment, financial resources for health care delivery, and the availability of necessary health drugs [19]. Thus, even when pregnant women overcome all the constraints associated with the physical access to prenatal care services, they may still face yet other obstacles related to the quality of the services provided. In this context, cluster-level or community-level factors potentially become essential components of the use of prenatal care services.

2. Methods

2.1. Data source

The empirical analysis uses data from two rounds of the nationally representative Zimbabwe Demographic and Health Survey (ZDHS) conducted in 2005/06 and 2010/11. The ZDHS collects detailed health information for women of reproductive ages 15–49 and their children. The survey used a stratified two-stage cluster sample design based on the Zimbabwe population census of 2002. The first stage involved a random sampling of the enumeration areas followed by a random sampling of households (excluding individuals living in institutional facilities such as army barracks, hospitals, police camps, and boarding schools) at the second stage.

Of the 9870 eligible women in the 2005/06 ZDHS, 8907 were successfully interviewed, yielding a response rate of 90% [20]. Among the 9831 eligible women in the 2010/11, 9171 were successfully interviewed, resulting in a response rate of about 93% [18]. The analysis in this study uses the individual woman data file, which contains both parental and household characteristics including detailed prenatal care information for the most recent birth that occurred within the five years before each survey. We supplemented the ZDHS data with health facilities data obtained from the Zimbabwe Statistical Agency (ZIMSTAT) and other country-specific reports on health resources.

Since we used a pooled cross-sectional sample, we adjusted the survey weights such that the initial sampling probabilities were preserved in either survey. Then, we re-scaled the sampling weights such that each survey received an equal weight and making the simplifying assumption that the overall population in Zimbabwe did not significantly change to the extent of altering our study conclusions. The final sample weights consist of the original ZDHS weights adjusted to reflect the consequence of pooling across multiple waves. All our estimates especially summary statistics are weighted to be nationally representative.

2.2. Measures of prenatal care

This study considers three outcome variables to measure the frequency, timing and quality of prenatal care. We use the responses to different questions on prenatal care asked during each survey. Each respondent in the ZDHS, who had given birth five years preceding each survey, was asked to provide information regarding her most recent pregnancy. Follow-up questions were asked on who had provided the care, how many visits they had completed and the specific services they had received during each prenatal care visit.

2.2.1. Formal antenatal care use

All the women were first asked a general question regarding the receipt of any prenatal care. Each respondent was asked: “Did you see anyone for prenatal care for this pregnancy?” If yes, each respondent was asked to state whether they had seen a doctor, nurse or midwife, auxiliary midwife, traditional birth attendant, community village health worker or any other person. We use the response to this question to create a binary variable equals 1 if the respondent received some form of prenatal care during pregnancy and 0 otherwise.

2.2.2. Timing of prenatal care

For the subsample of women who sought prenatal care, another follow-up question regarding the timing of care was asked: “How many months pregnant were you when you first received prenatal care for this pregnancy?” Possible responses ranged from 0 to 9 months with 0 being the earliest and 9 the late prenatal care initiators. Globally, prenatal care initiated in the first trimester is the highly recommended option for all pregnant women [9,21]. We created a binary indicator equals 1 if prenatal care was initiated in the first trimester (three months of pregnancy) and 0 otherwise.

2.2.3. Frequency of prenatal care

Respondents who had gone for prenatal care were further asked another question regarding the number of visits they had completed. More specifically, each respondent was asked this question: “How many times pregnant were you when you first received prenatal care for this pregnancy?” The responses ranged from 0 to 9 visits with 0 being the earliest and 9 the late prenatal care initiators. We use the response to this question as our measure for the frequency of antenatal care services.

2.2.4. Quality of antenatal care use

Lastly, the subsample of prenatal care users was further asked a series of questions about the specific services they had received during each prenatal care visit. “As part of your prenatal care during this pregnancy, were any of the following services done at least once: (1) was your blood pressure measured? (2) Did you give a urine sample? (3) Did you give a blood sample? (4) during any of your prenatal care visit(s) were you told about things to look out for that might suggest problems with the pregnancy?, (5) during this pregnancy were you given an injection in the arm to prevent the baby from getting tetanus or convulsions after birth?, (6) during this pregnancy, were you given or did you buy any iron tablets or syrup?, (7) during this pregnancy, did you take any drugs to keep you from getting malaria?. Each response was coded as 1 if a specific service was received and 0 otherwise. Following Deb and Sosa-Rubi [22] we then created an index to measure the quality of prenatal care by adding all the “yes” responses for each woman.

2.3. Explanatory variables

The decision to utilize prenatal care services is thought to depend on a set of individual characteristics, household...
characteristics, and community-level factors. The individual characteristics included in all our regressions are: the age of the woman at child birth; years of education, employment status (=1 if employed; 0 otherwise) at the time of survey, health insurance status (=1 if insured; 0 otherwise), marital status (=1 if married; 0 otherwise), pregnancy desire (=1 if pregnancy wanted; 0 otherwise), number of births in the last five years, access to information (=1 if listens to the radio at least once a week; 0 otherwise); (=1 if reads newspapers at least once a week; 0 otherwise)), household size, household wealth (low (=1 if quintile 1 or 2; 0 otherwise); average (=1 if quintile 3; 0 otherwise); high (=1 if quintile 4 or 5; 0 otherwise)). At the community-level, we included measures for religious composition (% Christians in cluster of residence), contraceptive prevalence (% in cluster), number of nurses per 100,000 capita, health expenditures per capita (in United States dollars), a binary indicator for rural/urban residency, and an indicator for the availability of hospitals in district of residence. We also included an indicator for the year of survey (=1 if surveyed in year 2010/11; 0 otherwise). For the analysis, we converted the number of nurses per 100,000 capita and health expenditures per capita to natural logarithms so as to smoothen the data.

2.4. Econometric analysis

To model the use of prenatal care services, we first estimate a standard logit regression model specified as follows:

$$\ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1X_i + \beta_2V_i + \epsilon_i$$

(1)

where $\pi$ is the probability that a pregnant woman used prenatal care during her most recent pregnancy and 0 otherwise, $\frac{\pi}{1-\pi}$ is the odds ratio, $X_i$ is a vector of individual and household-level characteristics, $V$ is a vector of community-level features, and $\epsilon_i$ is a disturbance term. Since the timing of prenatal care is measured using a binary indicator taking 1 if care was sought in the first trimester of pregnancy and 0 otherwise, we use Eq. (1) to estimate the factors associated with this decision. Second, we express the frequency of prenatal care visits as a linear function of the predictors and estimate a linear model of the following form:

$$Y_i = \alpha + \delta_1X_i + \delta_2V_i + \epsilon_i$$

(2)

where $Y_i$ represents the frequency or quality of prenatal care by the $i^{th}$ woman and $\epsilon_i$ is an error term. This model is estimated using a generalized linear model (GLM) and heteroskedastic robust standard errors [23]. Since the quality of prenatal care is measured using the prenatal care index ranging from 0 to 7, we use the GLM as specified in Eq. (2). As a robustness check, we also use a two-level mixed logit (for binary indicator variables) and a linear mixed effect model (for continuous outcomes) [24]. Here, children (level one units) are nested in clusters or primary sampling units (level two). To formally test the influence of cluster-level variables, we concentrate on the change in the median odds ratio (MOR) [25] and the intra-class correlation coefficients after including the cluster-level variables. The MOR compares the odds ratios of two individuals with similar explanatory variables and randomly chosen from different clusters [25]. In our case, the MOR is therefore defined as the median odds ratio between a pregnant woman living in a cluster with a higher prenatal care utilization rate and a pregnant woman living in a cluster with a lower probability of prenatal care use. All the analysis was conducted using STATA version 13.0 [26].

3. Results

3.1. Descriptive statistics

Table 1 presents the survey-weighted means of the variables stratified by rural and urban status. The average age at birth is 26.57 years. Many of the women in our sample are married (95%), 42.68% are Christians, 3.19% had no formal education, and only 37.92% were employed at the time of the survey. Regarding health insurance, only 6.71% had some form of health insurance, 59.77% used a modern family planning method, 19.53% indicated they never wanted their pregnancy at the time of conception while 10.86% had previously terminated a pregnancy. Concerning access to information, nearly 37.11% of the women read newspapers at least once a week while 51.64% indicated listening to the radio at least once every week. The average household size was 5.62 people with rural households having larger family sizes than their urban counterparts across the survey years.

Regarding the quality of prenatal care, urban residents receive relatively higher quality prenatal care than their rural counterparts over the two years (4.58 vs. 3.71 in 2005/06 and 4.43 vs. 4.04 in 2010/11) for urban and rural samples respectively. On the average, women in our sample complete at least 4.45 prenatal care visits and receives approximately 4.06 services during prenatal care. The data shows that on each prenatal care visit, each woman is likely to frequent prenatal care centers. This result is particularly true for women living in the countryside. Also, being well informed with rural households having larger family sizes than their urban counterparts across the survey years.

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Table 1
Descriptive statistics for selected variables used in the analysis.

| Variables                          | Overall       | ZDHS 2005/06 | ZDHS 2010/11 |
|------------------------------------|---------------|--------------|--------------|
|                                    | Mean (%)      | SD           | Mean (%)      | SD           | Mean (%)      | SD           |
| **Prenatal care variables**        |               |              |              |              |              |              |
| First trimester prenatal care      | 22.491        | 41.755       | 27.841       | 44.842       | 24.881       | 43.240       |
| Prenatal care visits               | 4.459         | 2.523        | 5.405        | 3.058        | 4.394        | 2.253        |
| Prenatal care quality index*       | 4.061         | 1.760        | 4.580        | 1.351        | 3.708        | 1.739        |
| Tetanus vaccinations               | 80.295        | 39.779       | 83.260       | 37.350       | 77.910       | 41.492       |
| Iron tablets                       | 47.462        | 49.938       | 41.498       | 49.294       | 44.180       | 49.669       |
| Blood pressure check               | 84.061        | 36.606       | 94.537       | 22.737       | 85.058       | 35.656       |
| Urban sample                       | 59.469        | 49.098       | 84.317       | 36.380       | 58.135       | 49.342       |
| Blood sample test                  | 70.708        | 45.513       | 87.753       | 32.797       | 55.140       | 49.744       |
| Pregnancy complications            | 51.889        | 49.967       | 61.850       | 48.597       | 39.040       | 48.792       |
| Malaria tablets                    | 12.172        | 32.699       | 4.758        | 22.876       | 1.341        | 2.253        |
| Maternal/household-level variables |               |              |              |              |              |              |
| Age at birth                       | 26.573        | 6.535        | 25.379       | 5.709        | 26.552       | 6.871        |
| Years of education*                | 8.337         | 2.930        | 9.428        | 2.004        | 7.117        | 2.728        |
| Employed                           | 37.922        | 48.522       | 38.952       | 48.784       | 37.278       | 48.362       |
| Health insurance                   | 6.715         | 25.029       | 19.370       | 39.536       | 3.134        | 17.426       |
| Married                            | 94.526        | 21.947       | 93.710       | 24.289       | 95.380       | 20.996       |
| Pregnancy wanted                   | 19.529        | 39.644       | 17.258       | 37.804       | 21.044       | 40.769       |
| Terminated pregnancy               | 10.856        | 31.110       | 7.742        | 26.736       | 11.962       | 32.457       |
| Births in last five years*         | 1.049         | 0.665        | 1.081        | 0.517        | 1.236        | 0.620        |
| Read newspapers at least once a week | 37.106      | 48.311       | 71.371       | 45.221       | 23.899       | 42.653       |
| Listen to radio at least once a week | 51.636     | 49.976       | 84.087       | 36.594       | 38.788       | 48.735       |
| Low wealth                         | 42.433        | 49.426       | 0.000        | 0.000        | 62.247       | 48.485       |
| High wealth                        | 39.329        | 48.850       | 97.984       | 14.061       | 13.133       | 33.781       |
| Household size*                    | 5.624         | 2.695        | 5.235        | 2.348        | 6.233        | 2.972        |
| **Community & location factors**   |               |              |              |              |              |              |
| Urban resident                     | 30.481        | 46.035       |              |              |              |              |
| Contraceptive prevalence (%) in cluster | 59.769    | 16.048       | 70.631       | 15.660       | 58.582       | 16.349       |
| Religious composition (% Christians) | 42.676    | 20.825       | 58.091       | 18.101       | 37.205       | 20.697       |
| Nurses per 100,000 capita           | 123.415       | 74.464       | 193.915      | 90.331       | 86.126       | 37.255       |
| District hospitals*                | 18.683        | 10.901       | 8.045        | 12.093       | 23.139       | 7.030        |
| Health expenditures per capita ($ U.S.) | 42.443    | 35.933       | 61.358       | 42.739       | 56.073       | 41.098       |

Notes: All estimates are weighted to be nationally representative. The means for all binary variables are expressed in percentage terms. All the variables are binary, except for those marked with an asterisk (*). SD = Standard deviation. ZDHS = Zimbabwe Demographic and Health Survey.
the quality of prenatal care as indicated by the chi-square statistics of 33.679 (p < 0.001) and 41.617 (p < 0.001) for the rural and urban areas respectively.

To check the robustness of our estimates, we estimated a series of two-level mixed logit regression models for binary outcomes and two-level linear mixed effect regressions. The results for these analyses are furnished in Table 5. The odds ratios and the marginal effects from all the models are consistent with our earlier estimates. Thus, our earlier findings are robust to change in the empirical model used. The MORs and ICC all show that cluster-level variables modestly influence the use of prenatal care services in Zimbabwe. For example, the MOR for the model for any prenatal care use declined by nearly 4.29% from the baseline specification (i.e. with no cluster-level variables) to about 2.340 after accounting for cluster-level variables. For frequency of prenatal care, the ICC declined by about 6.38% and showing the influence of cluster-level variables.

4. Discussion

This study sought to assess the importance of community-level factors on the frequency, timing and quality of prenatal care services in Zimbabwe. The sociodemographic factors such as the mother’s age at birth, education, and previous birth histories were all important in explaining the factors influencing the use of prenatal care services. Our results also show that family planning prevalence, religious composition, nurses per 100,000 capita, health expenditures per capita and government hospitals in community

| Variables | Rural sample | Urban sample | Overall sample |
|-----------|-------------|-------------|---------------|
|           | Frequency of visits | Frequency of visits | Frequency of visits |
|           | Odds ratio | 95% CI | Odds ratio | 95% CI | Odds ratio | 95% CI |
| Age at birth | 1.168*** | [1.052–1.295] | 1.081*** | [1.024–1.142] | 1.190*** | [0.984–1.441] |
| Age at birth squared | 0.997*** | [0.996–1.000] | 0.999*** | [0.998–1.000] | 0.999*** | [0.996–1.000] |
| Education (years) | 0.942*** | [0.739–1.202] | 1.031*** | [0.917–1.160] | 1.356*** | [0.954–1.926] |
| Employed | 0.943* | [0.739–1.202] | 1.031*** | [0.917–1.160] | 1.356*** | [0.954–1.926] |
| Health insurance | 7.252*** | [0.978–53.776] | 1.810*** | [1.143–2.866] | 1.289*** | [0.627–2.649] |
| Married | 1.535*** | [0.951–2.477] | 1.465*** | [1.163–1.844] | 1.637*** | [0.883–3.034] |
| Pregnancy wanted later | 0.780** | [0.625–0.974] | 0.834** | [0.737–0.943] | 0.713** | [0.485–1.048] |
| Births in last 5 years | 4.922*** | [0.406–0.596] | 0.695*** | [0.626–0.773] | 0.552*** | [0.393–0.775] |
| Reads newspapers (least once a week) | 1.252** | [0.954–1.529] | 1.297*** | [1.136–1.482] | 1.099*** | [0.869–1.505] |
| Listen to radio (least once a week) | 1.193*** | [0.902–1.595] | 1.217*** | [1.136–1.482] | 1.285*** | [0.930–1.763] |
| Household size | 0.954*** | [0.917–0.997] | 0.978*** | [0.958–0.999] | 0.976*** | [0.907–1.049] |
| Low wealth (quintiles 1 & 2) | 0.990 | [0.762–1.288] | 0.901 | [0.781–1.040] | 0.746 | [0.357–1.557] |
| High wealth (quintiles 4 & 5) | 1.400 | [0.922–2.126] | 1.042 | [0.840–1.291] | 1.036 | [0.858–1.287] |
| Community-level variables | | | | | | |
| Family planning (% in cluster) | 3.240*** | [1.284–8.174] | 1.271 | [0.828–1.949] | 3.397*** | [1.259–9.168] |
| Christians (% in cluster) | 2.432*** | [1.094–5.405] | 0.789 | [0.571–1.092] | 1.986 | [0.736–5.360] |
| Log (number of nurses) | 6.946*** | [3.491–13.821] | 0.428** | [0.293–0.624] | 2.530 | [0.831–7.705] |
| Log health expenditures | 1.144*** | [0.906–1.444] | 1.237*** | [1.094–1.397] | 1.785*** | [1.190–2.679] |
| Year of survey is 2010/11 | 0.480*** | [0.347–0.665] | 1.076 | [0.910–1.272] | 0.640*** | [0.378–1.083] |
| District hospital | 2.497*** | [1.080–5.773] | 1.295 | [0.879–2.124] | 5.465*** | [3.288–9.083] |

Notes: All estimates are weighted to be nationally representative. The estimates shown are coefficient estimates from the two-part model. ***Significance at 1% level; **significance at 5% level; *significance at 10% level (all are based on robust standard errors). The dependent variables are (1) any care (binary) and (2) total number of prenatal care visits completed for the most recent pregnancy.
of residence are all important predictors of the utilization of prenatal care services when considered jointly. These findings are consistent with previous other studies especially for developing countries [4,27].

Our results indicate that high contraceptive prevalence rates positively correlate with prenatal care among rural pregnant women. This result might be explained by the fact that women living in clusters with higher contraceptive prevalence rates are likely...
Table 5
Multilevel estimates: Prenatal care utilization in Zimbabwe, 2005–2011.

| Variables                      | Any form of prenatal care | Frequency of visits | First trimester care | Prenatal quality |
|-------------------------------|---------------------------|--------------------|----------------------|------------------|
|                               | Odds ratio | SE | Odds ratio | SE | Coef | SE | Coef | SE | Odds ratio | SE | Odds ratio | SE | Coef | SE | Coef | SE |
| Age at birth                  | 1.171** | (0.058) | 1.168** | (0.058) | 0.100** | (0.031) | 0.095** | (0.034) | 1.081 | (0.036) | 1.078 | (0.036) | 0.093*** | (0.021) | 0.092*** | (0.023) |
| Age at birth squared          | 1.091*** | (0.022) | 1.089*** | (0.022) | 0.083*** | (0.012) | 0.083*** | (0.013) | 1.021 | (0.013) | 1.024 | (0.013) | 0.074** | (0.008) | 0.073** | (0.009) |
| Education (years)             | 1.089 | (0.111) | 1.081 | (0.110) | 0.157** | (0.057) | 0.138** | (0.065) | 1.102 | (0.063) | 1.076 | (0.062) | 0.036 | (0.039) | 0.032 | (0.040) |
| Married                       | 1.784*** | (0.343) | 1.684*** | (0.327) | 0.627*** | (0.120) | 0.573*** | (0.214) | 1.408 | (0.188) | 1.334 | (0.180) | 0.147 | (0.082) | 0.129 | (0.094) |
| Pregnancy wanted later        | 0.724** | (0.072) | 0.731** | (0.073) | 0.259** | (0.063) | 0.259** | (0.048) | 0.894 | (0.060) | 0.892 | (0.060) | 0.209*** | (0.043) | 0.206*** | (0.015) |
| Births in last 5 years        | 0.475*** | (0.038) | 0.497*** | (0.042) | 0.656*** | (0.054) | 0.583*** | (0.032) | 0.674*** | (0.042) | 0.735*** | (0.048) | 0.365*** | (0.037) | 0.339*** | (0.028) |
| Reads newspapers (at least once a week) | 1.259 | (0.147) | 1.295*** | (0.152) | 0.306*** | (0.064) | 0.312*** | (0.088) | 1.139 | (0.075) | 1.172 | (0.078) | 0.239*** | (0.044) | 0.248*** | (0.056) |
| Listens to radio (at least once a week) | 1.326 | (0.133) | 1.347*** | (0.135) | 0.294*** | (0.058) | 0.292*** | (0.078) | 1.144 | (0.069) | 1.152 | (0.070) | 0.182*** | (0.040) | 0.187*** | (0.048) |
| Household size                | 0.951*** | (0.016) | 0.952*** | (0.016) | -0.040*** | (0.010) | -0.035*** | (0.010) | 0.978 | (0.010) | 0.979 | (0.010) | -0.015*** | (0.007) | -0.014*** | (0.007) |
| Low wealth (quintiles 1 & 2)  | 1.034 | (0.131) | 1.035 | (0.132) | -0.062 | (0.076) | -0.051 | (0.072) | 0.921 | (0.072) | 0.913 | (0.072) | 0.127*** | (0.052) | 0.125*** | (0.046) |
| High wealth (quintiles 4 & 5) | 0.991 | (0.145) | 1.136 | (0.183) | 0.084 | (0.083) | 0.091 | (0.097) | 0.927 | (0.077) | 1.070 | (0.095) | 0.207*** | (0.058) | 0.237*** | (0.078) |
| Year of survey is 2010/11     | 0.498*** | (0.057) | 0.432*** | (0.080) | 0.041*** | (0.062) | -0.045*** | (0.065) | 0.673*** | (0.041) | 0.905 | (0.101) | 0.119*** | (0.046) | 0.040 | (0.078) |

Community/cluster—level variables

| Family planning (% in cluster) | 2.712*** | (1.043) | 0.768*** | (0.448) | 1.019 | (0.201) | 0.392*** | (0.246) |
| Christians (% in cluster)      | 1.868*** | (0.586) | 0.190 | (0.203) | 1.067 | (0.169) | 0.346*** | (0.190) |
| Log (number of nurses)         | 3.932*** | (2.094) | 0.840*** | (0.699) | 0.575 | (0.199) | 0.695*** | (0.416) |
| District hospital              | 2.177*** | (0.401) | 0.234*** | (0.122) | 1.547*** | (0.145) | 0.294*** | (0.098) |
| Log health expenditures        | 1.315*** | (0.150) | 0.269*** | (0.074) | 1.219*** | (0.069) | 0.127*** | (0.044) |
| Number of observations         | 8453     | 8453    | 8453    | 8453    | 8453    | 8453    | 8453    | 8453    |
| Mean of the dependent variable | 0.926    | 0.926   | 4.456   | 4.456   | 0.225   | 0.225   | 0.406   | 0.406   |
| Chi-squared, comparison model  | 123.294  | 101.146 | 83.313  | 75.276  | 25.607  | 21.903  | 319.074 | 291.590 |
| p-value                        | 0.000    | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   |
| Intraclass correlation coefficient (ICC) | 0.047 | 0.044 | 1.434 | 1.412 | 0.101 | 0.096 | 4.95% |

Notes: *Significant at 1% level; † significant at 5% level; ‡ significant at 10% level. Reported are the odds ratios from a two-level mixed effect logit regression model and their standard errors shown in parentheses. SE = Standard error, CAOEF = Coefficient or marginal effect. The dependent variables “Any form of prenatal care” and “first trimester care are binary (1/0) indicator variables while frequency of visits and prenatal quality are continuous variables.
to share other information regarding maternal care including prenatal care use. Alternatively, women are likely to receive prenatal care information during family planning education programs and will likely share this information with their neighbors and friends. The finding that religious composition positively correlates with prenatal care use might be a reflection of the critical role played by faith-based organizations in developing countries which help raise awareness on the benefits of prenatal care services thus enhancing its use. This study also found a positive association between health expenditures per capita and the frequency, timing and quality of prenatal care and not on the use of some form of prenatal care. The last result is consistent with the finding of Kruk, Galea [28]. This latter observation might be because some prenatal care use is provided nearly universally. In Zimbabwe, nine out of every ten pregnant women reported having some form of prenatal care for their most recent pregnancy [18]. We also found that per capita health expenditures were associated with timely use of prenatal care among rural women. This finding might be explained by the fact that rising health expenditures per capita possibly imply improvements in government financing which consequently lowers the out-of-pocket expenditures on prenatal care which in turn improves timely access. This result is in-line with the findings in Abrokawah, Moser [29].

5. Conclusions

This study sought to assess the importance of community-level factors on the frequency, timing and quality of prenatal care in Zimbabwe. Though individually not always statistically significant, community-level factors are important predictors of the use of prenatal care services in Zimbabwe when considered jointly. The results underscore the need for public health policymakers to improve health insurance coverage, design community-specific programs to educate women on family planning, and allocate more health resources to communities to improve prenatal care utilization.

Competing interest

The authors declare that they have no competing interests in connection with this manuscript.

Ethics approval

Ethical approval was not necessary for this study. We were granted permission to use the data for the analysis by MEASURE DHS and the Zimbabwe Statistical Agency (ZIMSTAT).

Author contributions

M.M. designed and led the statistical analysis, results interpretation and drafted the manuscript; C.M. helped with the data analysis and interpretations of the results. Both authors approved the final version of the manuscript.

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References

[1] WHO. World Health Statistics 2015. World Health Organization; 2015.
[2] WHO, UNICEF. UNFPA, The World Bank, United Nations Population Division. Trends in maternal mortality: 1990 to 2013. Estimates by WHO, UNICEF, UNFPA, The World Bank, United Nations Population Division. Geneva: World Health Organization; 2014.
[3] UNICEF. Levels and Trends In Child Mortality. In: Leston N, editor. Levels & Trends in Child Mortality, New York, 10017 USA: United Nations Children’s Fund; 2015.
[4] Manita P. Parental bargaining, health inputs and child mortality in India. J Health Econ 2004;23(2):269–91.
[5] Feresu SA, Harlow SD, Welch K, Gillespie BW. Incidence of stillbirth and perinatal mortality and their associated factors among women delivering at Harare Maternity Hospital, Zimbabwe: a cross-sectional retrospective analysis. BMC Pregnancy Childbirth 2009;9(1):9.
[6] Gajate-Garrido G. The impact of adequate prenatal care on urban birth outcomes: an analysis in a developing country context. Econ Dev Cult Change 2013;62(1):95–130.
[7] Awin JG. A multilevel analysis of prenatal care and birth weight in Kenya. Indian J Surg 2014;76(1):16p.
[8] Lincetto O, Mothebeseano-Anoh S, Gomez P, Munjusa J. Antenatal care. Opportunities for Africa’s newborns: Practical data, policy and programmatic suggestions for newborn care in Africa. 2006.
[9] Abu Zahr C, Wardlaw TM. Antenatal care in developing countries: promises, achievements and missed opportunities: an analysis of trends, levels and differentials, 1990–2001/prepared by Carla AbouZahr and Tessa Wardlaw; New York: World Health Organization; New York, UNICEF, 2003; 2003.
[10] Chakrabarti A, Chaudhuri K. Antenatal and maternal health care utilization: evidence from Northeastern States of India. Appl Econ. 2007;39(4–6):683–95.
[11] Magadi MA, Madise NJ, Rodrigues RN. Frequency and timing of antenatal care in Kenya: explaining the variations between women of different communities. Soc Sci Med 2000;51(4):551–61.
[12] Simkhada B, van Teijlingen ER, Porter M, Simkhada P. Factors affecting the utilization of antenatal care in developing countries: systematic review of the literature. J Adv Nurs 2008;61(3):244–60 17p.
[13] Habibov NN. On the socio-economic determinants of antenatal care utilization in Azerbaijan: evidence and policy implications for reforms. Health Econ Policy Law 2010;5:1–26.
[14] Colleran H, Mace R, editors. Social network-and community-level influences on contraceptive use: evidence from rural Poland. Proc R Soc B; 2015: The Royal Society.
[15] Widmer M, Betran AP, Merialdi M, Requejo J, Karpf T. The role of faith-based organizations in maternal and newborn health care in Africa. Int J Gynecol Obst 2011;114(3):218–22.
[16] Gage AJ, Calixte MG. Effects of the physical accessibility of maternal health services on their use in rural Haiti. Popul Stud 2005;60(3):271–88.
[17] Unicef. Levels and trends in child mortality. Estimates developed by the UN inter-agency group for child mortality estimation; 2015.
[18] ZIMSTAT. Zimbabwe Demographic and Health Survey 2010–11. Calverton, Maryland; 2012.
[19] WHO. Human Resources for Health, Country Profile Zimbabwe. CSO, Census 2002 & ICDs 2008; 2010.
[20] ZIMSTAT. Zimbabwe Demographic and Health Survey 2005–06. Harare: Central Statistical Office; 2006.
[21] Reichman NE, Corman H, Noonan K, Dave D. Infant health production functions: what a difference the data make. Health Econ 2009;18(7):761–82.
[22] Deb P, Sosa-Rubi SG. Does onset or quality of prenatal care matter more for infant health? Working paper; 2005.
[23] Beloti F, Deb P, Manning WG, Norton EC. Twopm: two-part models. Stata J 2015;15(1):3.
[24] Rabe-Hesketh S, Skrondal A. Multilevel and longitudinal modeling using Stata: STATA press; 2008.
[25] Larsen K, Merlo J. Appropriate assessment of neighborhood effects on individual health: integrating random and fixed effects in multilevel logistic regression. Am J Epidemiol 2005;161(1):81–8.
[26] Stata S. Release 13. Statistical Software College Station, Texas, USA: StataCorp LP; 2013.
[27] Muchabaiwa L, Mazambani D, Hgusiwa L, Bindu S, Mudavanhu V. Determinants of maternal healthcare utilization in Zimbabwe. Int J Econ Sci Appl Res 2012(5):2(2):145–62.
[28] Kruk ME, Galea S, Prescott M, Freedman LP. Health care financing and utilization of maternal health services in developing countries. Health Policy Plan 2007;22(5):303–10.
[29] Abrokawah SO, Moser CM, Norton EC. The effect of social health insurance on prenatal care: the case of Ghana. Int J Health Care Finance Econ 2014;14 (4):385–406.