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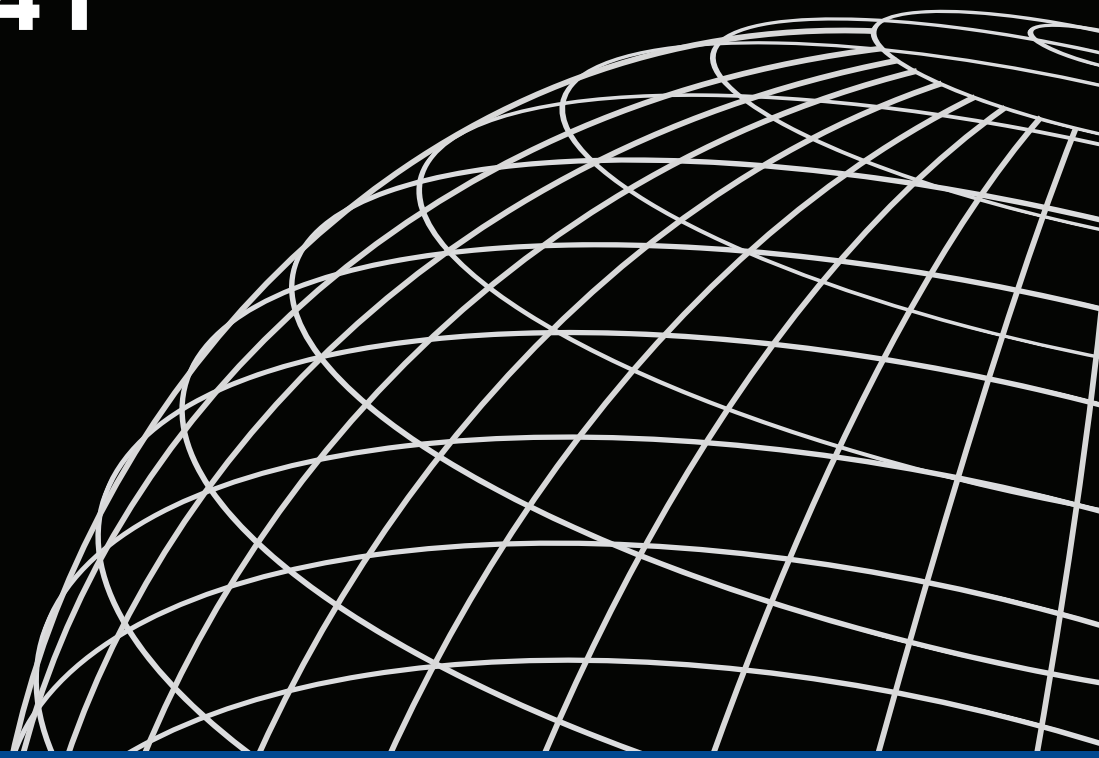
CONTEXTUAL INFLUENCES OF MODERN CONTRACEPTIVE USE AMONG RURAL WOMEN IN RWANDA AND NEPAL

DHS ANALYTICAL STUDIES 41



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The main objectives of the MEASURE DHS project are:

- to provide decision-makers in survey countries with information useful for informed policy choices;
- to expand the international population and health database;
- to advance survey methodology; and
- to develop in participating countries the skills and resources necessary to conduct high-quality demographic and health surveys.

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Contextual Influences of Modern Contraceptive Use among Rural Women in Rwanda and Nepal

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Preface

One of the most significant contributions of the MEASURE DHS program is the creation of an internationally comparable body of data on the demographic and health characteristics of populations in developing countries.

The *DHS Comparative Reports* series examines these data across countries in a comparative framework. The *DHS Analytical Studies* series focuses on analysis of specific topics. The principal objectives of both series are to provide information for policy formulation at the international level and to examine individual country results in an international context.

While *Comparative Reports* are primarily descriptive, *Analytical Studies* provide in-depth, focused studies on a variety of substantive topics. The studies are based on a varying number of data sets, depending on the topic being examined. These studies employ a range of methodologies, including multivariate statistical techniques.

MEASURE DHS staff, in conjunction with the U.S. Agency for International Development (USAID), selects the topics covered in *Analytical Studies.*

It is anticipated that the *DHS Analytical Studies* will enhance the understanding of analysts and policymakers regarding significant issues in the fields of international population and health.

Sunita Kishor
Project Director

Executive Summary

This study takes a multilevel approach to identify determinants of women's use of modern contraceptives in two diverse settings, Nepal and Rwanda. We explore the extent to which four spheres of community-level influence—socioeconomic development, women's empowerment, fertility norms, and access to family planning information and services—shape women's contraceptive use, after adjusting for women's individual socio-demographic characteristics and for other contextual factors.

Data for this study come primarily from the 2011 NDHS and the 2010 RDHS, and also draw from spatial data sources to measure community levels of socioeconomic development. The study focuses on rural women who do not wish to have a child within the next two years, a subset of women of particular interest to family planning policymakers. A sequence of random-effects logit regression models are run—separately for Rwanda and Nepal—to examine the variation in modern contraceptive use explained by each of the four selected spheres of community-level influences. A final model includes all four sets of community-level variables, as well as individual-level factors.

In the final model for both Rwanda and Nepal, community-level variables in each of the four spheres remain significant predictors of women's current use of modern contraception. After adjusting for women's individual characteristics, the community's level of socioeconomic development, the extent to which women in the community participate in decisions around family planning, prevailing small-family size norms, and the community's access to modern methods appear to be positively associated with women's contraceptive use.

Overall, results from this study indicate the relevance for family planning programs of the community context in which women live. The demand for family planning services is influenced not only by women's individual and household characteristics, but also by the community's socioeconomic development, its access and exposure to family planning, the gender norms of local community members regarding decision-making for family planning and health issues, and community norms regarding marriage and childbirth. Among the factors we explored, the analysis suggests that socioeconomic development and access to family planning services may play a bigger role in affecting women's contraceptive behaviors than the community's norms regarding gender and fertility.

1 Introduction

This study takes a multilevel approach to identify determinants of women's use of modern contraceptives in two diverse settings, Nepal and Rwanda, which offer two different contexts of family planning. Nepal has a longer history of family planning policy, and modern contraceptive prevalence among married women has been relatively high for over 15 years. It was already over 25 percent in 1996, 35 percent in 2001, and 44 percent in 2006, but appears to have stalled since then, estimated at 43 percent in the 2011 Nepal Demographic and Health Survey (NDHS) (Ministry of Health and Population (MOHP) [Nepal], New Era, & ICF International Inc., 2012).

In contrast, in Rwanda the family planning policy was implemented more recently. Modern contraceptive prevalence was quite low in 2000, at 6 percent. However, the 2010 Rwanda Demographic and Health Survey (RDHS) found modern contraceptive prevalence to be 45 percent, exceeding expectations (National Institute of Statistics of Rwanda (NISR) [Rwanda], Ministry of Health (MOH) [Rwanda], & ICF International Inc., 2012).

While Nepal and Rwanda each face unique challenges, both governments have invested heavily in population and family planning policies. Expanding the reach of family planning resources—so that women who do not wish to have a child right away are able to have appropriate contraceptive options—is currently a high priority for the governments of Rwanda and Nepal. Overall, the two governments have incorporated numerous strategies into their population policies. Both have focused largely on increasing the supply of family planning methods, so that women can access the methods of their choice. Both policies have recognized the relation between socioeconomic development and contraceptive use and have integrated these two goals. Both policies have also focused on altering social norms, to promote small family policies and to enhance the acceptability of the use of family planning. Finally, policymakers in both countries have understood the importance of women's empowerment to the success of family planning programs, and have included programs to promote women's education and labor force participation, along with efforts to address gender norms.

The proximate determinants of fertility and the influence of individual characteristics on modern contraceptive use have been well documented, but information on contextual influences is limited in comparison. Using the 2011 NDHS and the 2010 RDHS, this study will build on previous work that has examined contextual determinants of contraceptive use to examine multiple spheres of contextual influence and will be useful to inform policy makers in a variety of settings.

1.1 Context of Family Planning in Nepal

Family planning initiatives were first introduced in Nepal in the late 1950s by the Family Planning Association of Nepal (FPAN), a non-governmental organization. Government-supported family planning programs were initiated in 1968 with the implementation of Nepal's Third Development Plan (1965-1970), which first stated the need for a national population policy and identified family planning as a critical component of this policy (Ministry of Health and Population (MOHP) [Nepal], New ERA, & Macro International Inc., 2007).

Since then, family planning programs have expanded their goals and have increased the availability of family planning methods across Nepal. In addition to directing resources toward increasing the supply and availability of contraceptives and the reach of trained providers, family planning and population policies in Nepal have long focused on promoting a small family norm through education and media campaigns. They also have recognized the interconnectedness of women's status and fertility, promoting women's employment and education (Ministry of Health and Population (MOHP) [Nepal] et al., 2007).

Most recently, the Three-Year Interim Plan (2006/07 to 2009-10) put forth the goal to remove all costs of family planning services in the public sector. Family planning supplies are now available free of charge at public facilities in Nepal (Shrestha, Shrestha, & Ghimire, 2012). Temporary family planning methods can be obtained from a wide range of health facilities, including health posts and primary health care outreach clinics, and can also be obtained from periphery-level health workers and volunteers. More permanent contraceptive methods such as IUDs and implants are available at certain hospitals, primary health care centers, and health posts with trained staff. Sterilization services are provided at some health facilities and through mobile outreach services (Shrestha et al., 2012).

Between 1996 and 2011, fertility declined steadily in Nepal, from a total fertility rate (TFR) of 4.6 births per woman in 1996 to 4.1 in 2001, 3.1 in 2006, and 2.6 in 2011 (Ministry of Health and Population (MOHP) [Nepal] et al., 2012). This reduction in fertility was accompanied by an impressive rise in the use of modern contraceptives among currently married women. As mentioned, however, the contraceptive prevalence rate (CPR) remained stagnant between 2006 and 2011 (Ministry of Health and Population (MOHP) [Nepal] et al., 2012).

The stall in CPR has been attributed to several possible factors, including increased levels of spousal separation, failure to reach remote populations and special sub-groups with family planning supplies and services, and increased use of traditional family planning methods, abortion (following the introduction of a safe abortion policy in 2003), and emergency contraception (Shrestha et al., 2012). According to the 2011 NDHS, female sterilization remains the most prevalent form of contraception currently used by 15 percent of currently married women, while 9 percent of women use injectables, 8 percent rely on male sterilization by their partners, and 7 percent use traditional methods (Ministry of Health and Population (MOHP) [Nepal] et al., 2012).

Due to Nepal's mountainous terrain, some areas of the country are very remote. These rural areas tend to have fewer or inadequate reproductive health care facilities, fewer supplies and method choices, and insufficient health care professional staff, while the staff at health posts may not be trained to counsel women regarding family planning options. Spousal separation has also become a critical component of the family planning context in Nepal today; nearly one-third of married women age 15-49 had absent husbands at the time of the 2011 NDHS, and 11 percent of husbands had been away for at least a year (Khanal, Shrestha, Pant, & Mehata, 2013).

1.2 Context of Family Planning in Rwanda

Rwanda implemented its first family planning program in the early 1980s (May, Mukamanzi, & Vekemans, 1990). Since then the government has invested ample resources in making contraceptive methods available, affordable, and acceptable across the country (Wang, Wang, Pullum, & Ametepi, 2012). While family planning activities were suspended in the 1990s due to the Rwandan genocide, reproductive health and family planning services have received renewed attention since the early 2000s. In 2007 the Government of Rwanda prioritized family planning as part of its effort to reduce the country's high population growth rate, address poverty, and achieve development goals (Muhoza, Rutayisire, & Umubyeyi, 2013).

The government has taken a comprehensive approach to increasing family planning uptake, with an ambitious expansion of services, including the construction of new hospitals, health centers, and health posts in previously under-served areas; an increase in the range of methods available at existing facilities; expansion of trainings for medical staff in family planning service provision; and a decentralization of family planning service delivery in order to gain community support and participation (Muhoza et al., 2013). Between 2000 and 2013, Rwanda's family planning efforts have emphasized transforming community norms concerning family planning. The Government of Rwanda has led a widespread national

public education campaign to promote a small family size norm and proper birth spacing, to gain acceptance of family planning, and to frame population policy and family planning as an important means to achieving national development goals and reducing poverty (Muhoza et al., 2013).

Finally, Rwanda's family planning efforts have long acknowledged the interconnectedness of family planning uptake, socioeconomic development, and women's empowerment. To create an environment favorable to behavioral change that would in turn result in lower fertility rates, population and family planning policies have promoted women's education and school attendance, and the employment and advancement of women (National Institute of Statistics of Rwanda (NISR) [Rwanda] et al., 2012).

Rwanda's fertility rate remained at roughly six births per woman between 1992 and 2005, but the TFR declined rapidly between 2005 and 2010, from 6.1 to 4.6 births per woman (National Institute of Statistics of Rwanda (NISR) [Rwanda] et al., 2012). During this same period there has been a dramatic rise in modern contraceptive use among currently married women, from 6 percent in 2000 to 10 percent in 2005, 27 percent in 2007/08, and 45 percent in 2010 (MEASURE DHS STATcompiler). Injectables are the most prevalent contraceptive method among currently married women (26 percent), followed by the pill (7 percent), and implants (6 percent) (National Institute of Statistics of Rwanda (NISR) [Rwanda] et al., 2012).

1.3 Research Focus: Community-Level Influences on Modern Contraceptive Use

This study will focus on a subset of women of particular interest to family planning policymakers: rural women who do not wish to have a child within the next two years. We limit the study to rural women because they may face unique barriers to contraceptive use, such as geographic remoteness and lack of contraceptive options. We limit the study to women who do not wish to have a child right away because these are the women family planning programs hope to reach; thus, better understanding what influences their contraceptive behavior is of highest interest.

This study examines four realms of community-level influence—socioeconomic development, women's empowerment, access to family planning information and services, and fertility norms. We explore the influence of each these community realms on women's current use of modern contraception, after accounting for the influence of women's individual and household socioeconomic characteristics. Each realm of community influence could affect a woman's decision to use modern contraception, either by impacting her access to contraceptive supplies and services, or her decision to use contraceptives by influencing her desire for more children or her sense of the acceptability of family planning itself. These four realms are examined in more detail below.

1.4 Literature Review

Socioeconomic development

The community's overall level of economic development could affect women's contraceptive use through several pathways. Better roads and higher population density associated with development relate closely to women's geographic access to family planning. At the same time, living in a community with higher levels of socioeconomic development, better access to education, expanded employment opportunity, and more exposure to modern ideas could affect women's ideal family size and attitudes toward using family planning (Giusti & Vignoli, 2006).

Among the studies that have examined community-level determinants of women's contraceptive use, the majority have included measures of the community's socioeconomic development, with mixed findings (DeGraff, Bilsborrow, & Guilkey, 1997; Giusti & Vignoli, 2006; Stephenson, Baschieri, Clements,

Hennink, & Madise, 2007). In a study in Ethiopia, Giusti and Vignoli (2006) used the community's mean household wealth index score as a measure of the community's degree of modernization, and found it to be positively associated with women's level of contraceptive use. However, using a similar measure of community wealth, Stephenson and colleagues (2007) found that among six sub-Saharan African countries studied, in only two (Tanzania and Burkina Faso) was the community's mean score positively associated with women's modern contraceptive use.

Other community-level measures of socioeconomic development have been included in studies modeling women's contraceptive use, including the percentage of women with access to piped water (Kaggwa, Diop, & Storey, 2008), the presence of asphalt or concrete roads in a community, the distance to the nearest population center, and the presence of electricity, irrigation, and secondary schools (DeGraff et al., 1997), and the type of habitat (Stephenson et al., 2007). However, these indicators were not found to be determinants of contraceptive use.

Women's empowerment

There is ample evidence that women's personal level of empowerment affects their contraceptive use (Barbieri & Hertrich, 2005; Kaye, Mirembe, Bantebya, Johansson, & Ekstrom, 2006). In a study using DHS data from 18 sub-Saharan African countries, for example, Barbieri and Hertrich (2005) examined spousal age difference as a proxy for gender inequality within the couple and found that being at least 15 years younger than one's husband was associated with lower levels of contraceptive use. Women's educational attainment, employment status, and discussion of family planning with one's partner have also been correlated with women's use of contraceptives (Kimuna & Adamchak, 2001).

A smaller body of research has examined community-level measures of women's empowerment as determinants of contraceptive use (DeGraff et al., 1997; DeRose & Ezeh, 2010; Moursund & Kravdal, 2003; Speizer et al., 2009; Stephenson, Beke, & Tshibangu, 2008). The rationale behind this research is that a woman's contraceptive behavior is likely to be influenced not only by her own level of autonomy but also by the level of autonomy of other women in her community, and by prevailing gender norms.

Many of these studies have found a positive relationship between contraceptive use and community-level measures of gender attitudes and women's empowerment. DeGraff and colleagues (1997) found that the community-level average wage for women—interpreted as a measure of women's status and independence—had a positive effect on women's contraceptive use. Building on this finding, Stephenson and colleagues (2008) found that among sexually active women currently using a method of contraception in South Africa, the proportion of women in a community with control over their own earnings was positively associated with women's use of the pill or another more permanent method of contraception, rather than injectables. They also found that the proportion of women in a community with only a primary education—another measure of women's autonomy—was inversely associated with women's use of a more permanent method of contraception, rather than injectables.

DeRose and Ezeh (2010), using data from the 1995-96 Negotiating Reproductive Outcomes Study, conducted in Uganda, examined the influence of both individual and community-level measures of women's control over household decision-making on the adoption of modern contraceptive methods. The study found that women in communities where women more commonly have control over household decisions were 29 percent more likely to use modern contraception compared with women in communities where women have less decision-making power, independent of individual and community educational attainment.

Finally, women's experience of domestic violence has been found to be a risk factor for unwanted pregnancy and for induced abortion (Kaye et al., 2006). Community-level measures of spousal violence

have also been correlated with contraceptive use. In a sample of sexually-experienced unmarried youth in South Africa, Speizer and colleagues (2009) found that youth from communities with higher levels of sexual violence were less likely to have used a condom at last sex, were more likely to have had a pregnancy during adolescence, and were more likely to be HIV-positive compared with youth from communities with lower levels of sexual violence.

Fertility norms

In general, an individual's decisions are shaped by the perceived attitudes and behaviors of others in the community (Rimal & Real, 2003). Community norms regarding family size and family planning, then, are likely to influence women's own attitudes, and ultimately influence their use of family planning. While family planning programs both in Nepal and Rwanda have sought to transform norms concerning family size ideals and fertility behavior, few studies in these two settings have examined the extent to which community norms around family planning may explain geographic variation in contraceptive use.

Studies in other settings have had mixed findings regarding the extent to which community-level norms around family planning and family size affect women's use of modern contraceptives (Kaggwa et al., 2008; Stephenson et al., 2007). In Mali, Kaggwa and colleagues (2008) found that after controlling for individual-level factors, there was no evidence that women's use of modern contraceptives was affected either by community norms about desired family size (measured by the proportion of women desiring four or fewer children and the mean number of births per woman), or by attitudes toward family planning (measured by the proportion of women in the community who approved of family planning).

In their study of six sub-Saharan African countries, however, Stephenson and colleagues (2007) found that in four of the countries (Kenya, Malawi, Tanzania, and Ghana), after adjusting for individual and other community-level factors, the percentage of women in the community approving of family planning was positively associated with individual women's current use of modern contraceptives. In Kenya, men's community-level approval of family planning was a significant positive predictor of women's contraceptive use; this association held even after adjusting for the partner's approval of family planning at the individual level, indicating a community influence above and beyond that of the nuclear family.

The normative context in South Asia is likely to be different than the context in sub-Saharan Africa. In contrast to Rwanda, a preference for sons appears to influence fertility and family planning norms in Nepal. An ethnographic study among Hindu women in one semi-urban village of Nepal found that women had internalized the expectations of their society, community, and family and felt a strong pressure to produce sons (Brunson, 2010). Nepal is a patriarchal society; particularly in rural areas there is a persistent culture of obedience to one's husband (Stash, 1999). In Nepal, husband's approval of family planning has been shown to be a pivotal determinant of women's contraceptive use (Kamal & Lim, 2010).

Family planning information and services

There is widespread agreement that expanding access to family planning services and supplies leads to increased use of contraceptives. In addition to helping meet a community's current demand for family planning, increasing the availability of family planning information and services can enhance the desirability and acceptability of using family planning among members of the community, and thus stimulate more demand for contraception.

The majority of studies examining the effect of family planning service provision on contraceptive use has relied on data collected at the health-facility level to assess the availability and quality of family planning services, and then has linked these data with women's individual survey data to assess their relationship with women's contraceptive use. Such linked studies have been undertaken since the 1970s,

when countries surveyed as part of the World Fertility Survey (WFS) often included a community-level module with information on service availability. Some DHS surveys before 2000 also included a service availability module.

Studies using these earlier survey data provided empirical evidence that women's contraceptive use is shaped at least to some extent by the availability of services, and also by the perceived quality of those services (Magnani, Hotchkiss, Florence, & Shafer, 1999; Mensch, Arends-Kuenning, & Jain, 1996; T Pullum, 1991; Steele, Curtis, & Choe, 1999). For example, Steele and colleagues (1999) linked data from the 1995 Morocco DHS with data from the 1992 Morocco DHS service availability module to study the impact of family planning service provision on women's contraceptive use. Using multilevel models that adjusted for individual women's characteristics, they found that the presence of a nearby public health center was associated with higher rates of adoption of a modern method after giving birth, and with lower contraceptive method failure rates.

Similarly, in a study linking DHS data from Peru with data from a situation analysis, Mensch and colleagues (1996) found that the quality of family planning care available in a community had an effect on women's contraceptive use, independent of women's individual and household characteristics. The authors estimated that contraceptive prevalence would have been 16 to 23 percent higher if all women lived in a community with the highest quality of care compared with the lowest.

While important, these studies have methodological issues. Some studies used cluster-level health facility data in the individual-level analysis without specifying in their statistical models that cluster-level data could only explain variation between clusters in contraceptive use. Additionally, the DHS service availability modules were based on interviews with key informants rather than on information obtained directly from health facilities, and were not necessarily representative of all health facilities in the country. Finally, while many of these studies adjusted for women's characteristics and for household characteristics, few adjusted for other spheres of community influence, which would provide useful information on the relative importance of different aspects of women's physical and social environments.

Since the late 1990s, MEASURE DHS has conducted the Service Provision Assessment (SPA) surveys to collect information on health facilities. SPA data provide nationally representative detailed information about the health service environment. Several studies have used GIS coordinates of health facilities and of DHS clusters to link SPA and DHS data. Using data from the 2002 Egypt Service Provision Assessment (ESPA) survey and the 2003 Egypt Interim Demographic and Health Survey (EIDHS), Hong and colleagues (2006) found that the quality of available family planning services was positively associated with women's use of the IUD, independent of the distance to the facility, the facility type, and women's individual demographic characteristics (Hong, Montana, & Mishra, 2006).

However, there are important methodological challenges concerning analysis linking DHS and SPA data. Most often, SPA surveys use a sample of all private and public facilities, rather than a complete census, and this sample is not typically designed to be representative beyond the regional level. Linking these data at lower levels of geographic disaggregation than the sample was designed to permit can produce large misclassification errors (Skiles, Burgert, Curtis, & Spencer, 2013). Furthermore, there is often a gap between when the facility data and the women's data were collected, so the study must make the assumption that the service environment did not change during this time. Finally, while this type of linkage also makes the assumption that cluster-level summaries accurately describe women's individual service environment and access, some portion of women are likely to travel outside their cluster for family planning services.

A less common method of assessing the family planning service environment is to aggregate women's individual responses on their contraceptive use to the cluster level, in order to make inferences about the

local service environment. This strategy to our knowledge has not been used in studies examining the effect of access to family planning services on contraceptive use, but has been used in other analyses of reproductive health service utilization. Using DHS data from Malawi and Kenya, Pullum and colleagues (2006) examined women's survey responses regarding respondents' source of supplies for family planning, place of childbirth, and place to obtain an AIDS test, in order to draw inferences about the acceptability of integrating those services. A key component of the study was to control for the availability of services, so that limited availability would not be misinterpreted as preference. In order to assess the cluster-level availability of services, the study counted the total number of different types of facilities that women reported using within a cluster, and used this count as a proxy for the total number of facilities available in that cluster (Thomas Pullum, Cleland, & Shah, 2006).

Our study will use a similar strategy to assess health service availability at the cluster level. While imperfect, aggregate measures provide a useful proxy for the availability and reach of family planning services within a cluster, and this approach avoids the many methodological challenges associated with facility data.

2 Data and Methods

2.1 Data and Measurements

This analysis primarily uses data from the most recent DHS surveys in Rwanda (2010) and Nepal (2011). DHS surveys typically adopt a two-stage sample design in countries after ensuring representativeness at the level of the region, and in urban and rural areas. The first stage involves selecting clusters (usually neighborhoods in urban areas and villages in rural areas) with probability proportional to size from a national master sample frame. During this stage, 492 clusters were selected in the Rwanda survey and 289 clusters were selected in the Nepal survey.

At the second stage, a random systematic sample of households is drawn from a listing of households in each of the DHS clusters. All women age 15-49 in the selected households are eligible for the individual interview. For the purpose of this analysis, we focus on currently married women in rural areas in both countries. We further limit the analysis to women who did not want (or were not sure if they wanted) a birth in the next two years from the date of the survey. In the end, 5,460 women from 411 clusters in Rwanda and 7,502 women from 194 clusters in Nepal who met the criteria (currently married, living in rural areas, and wanting to avoid childbearing for at least two years) were included in our analysis.

Outcome variable

The outcome variable for this analysis is women's current use of any modern contraceptive methods including female sterilization, male sterilization, IUD, injectables, pill, implants, male condom, lactational amenorrhoea method, and standard days method. In the survey women could give multiple methods, but this study considers the most effective method as their current contraceptive method.

Contextual variables

The main focus of the analysis is on community-level influences, measured at the DHS cluster level, on women's modern contraceptive use. The indicators of community-level influences, which were selected based on the research literature and data availability, are listed below:

1) Community's socioeconomic development
    a. Region/Province
    b. Distance to a main road
    c. Distance to a large city
    d. Low population density
    e. Female educational attainment
2) Women's empowerment
    a. Women's experience of domestic violence
    b. Women's participation in household decision-making on own health care
    c. Women's participation in decision-making on family planning use
3) Community fertility norms
    a. Average age at first marriage
    b. Average interval between marriage and first birth
    c. Average number of children desired
4) Community access to family planning information and services
    a. Access to modern contraception
    b. Exposure to family planning messages
    c. Contacts with family planning providers

Table 1 presents the operational definitions of the variables. Most of the variables were obtained by aggregating individual-level responses to the cluster level, with the exception of three socioeconomic development measurements, as described below:

Measurements of socioeconomic development

Three geographic variables were merged with the DHS clusters to create the measures of socioeconomic development: distance to main road, distance to the nearest city of 50,000 people, and the cluster's population density. The distances in meters to the nearest main road and nearest city of 50,000 were calculated using ArcGIS Desktop (ESRI, Redlands, CA) tools and extensions. Data were obtained from the CIESIN website including the Global Roads Open Access Data Set (gRoads) and for the cities the Global Rural Urban Mapping Project. A list of cities with populations of 50,000 or more (according to the 2002 census in Rwanda and 2011 census in Nepal) was taken from the City Population website (http://www.citypopulation.de/).

In DHS, GPS locations are recorded at an estimated center of the sampled cluster. These locations are then displaced to maintain the confidentiality of respondents. Rural clusters are displaced up to 5 kilometers with 1% of rural locations are displaced up to 10 kilometers (Perez-Heydrich, Burgert, & Emch, 2013). The analysis took into account the displacement by using categories instead of exact distances in the measurements.

The variable related to population density was categorized into groups as indicated in Table 1. The calculation of the population density for each cluster used the AfriPop and AsiaPop data layers, which are population density estimates for approximately 100 square meters from 2010 adjusted to match UN population estimates. The mean population density for the buffers of 10km around the DHS rural cluster points was calculated. Finally, a variable indicating low density was created with two categories: 1-bottom 20% of clusters according to population density, 0-other clusters. The maps (Figures 1 and 2) below display the DHS clusters in rural areas included in the Rwanda and Nepal surveys, as well as the variable of population density estimated for some clusters.

Female education attainment measured by women's average years of schooling in the cluster is also included as a socioeconomic development indicator. This variable was calculated based on the responses from all interviewed women in the cluster.

Figure 1. DHS clusters in rural areas in the 2010 Rwanda DHS and population density estimated for some clusters

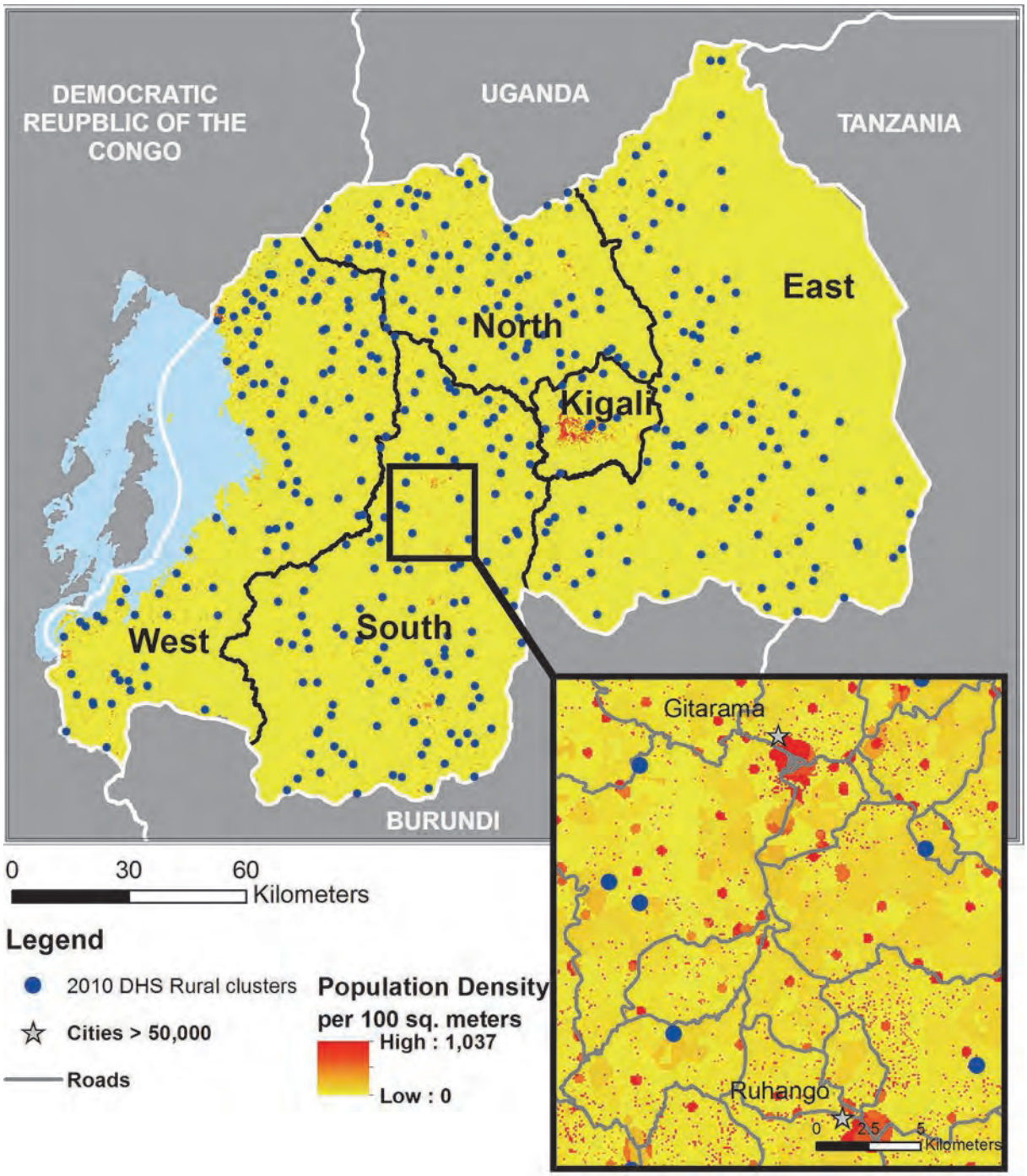
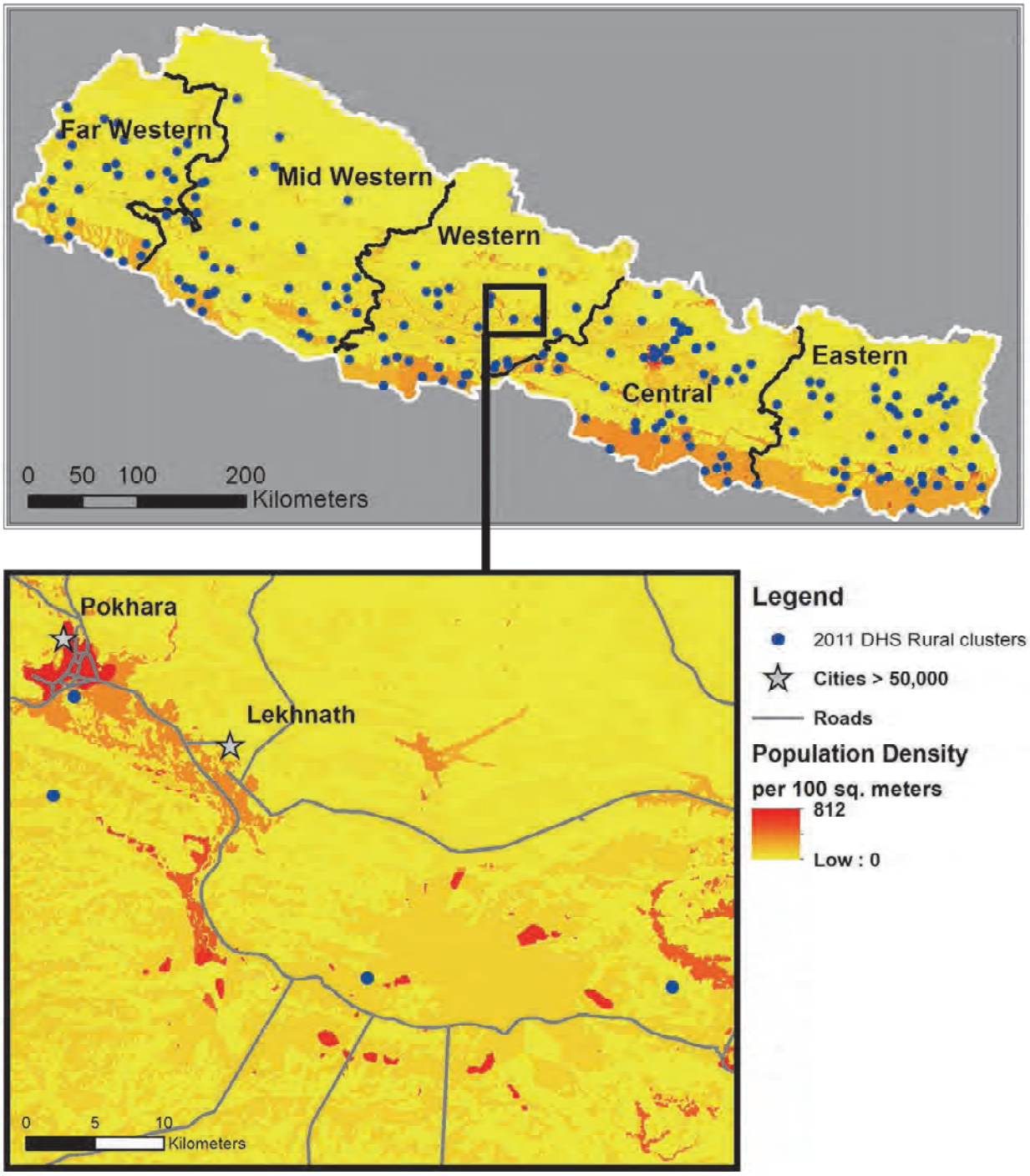


Figure 2. DHS clusters in rural areas in the 2011 Nepal DHS and population density estimated for some clusters



Measurements of women's empowerment

All of the women's empowerment variables were obtained by aggregating individual-level data to the cluster level. Women's experience of domestic violence was measured based on women's responses to a set of questions related to physical or sexual violence perpetrated by their husbands/partners. In both Rwanda and Nepal, the domestic violence module covered a subsample of households included in the DHS survey. In our study the cluster-level variable—percentage of women in the cluster who reported spousal physical or sexual violence—was calculated among the households selected for the domestic violence module.

Two variables on women's participation in household decision-making were analyzed—decisions on women's own health care and decisions on family planning. Women were considered to participate if they make these decisions either by themselves or jointly with their husbands. While data on the percentage of women participating in decision-making for their own health care were based on all interviewed women in the cluster, data on decision-making on family planning use were limited to women who currently use a family planning method (modern or traditional).

Measurements of fertility norms

Women's average age at first marriage and mean number of children desired by women in the cluster were based on all married women interviewed in the cluster. For the variable of longer interval between marriage to first birth, we first calculated the interval (in months) between marriage and the first birth, then further dichotomized it by comparing it with the overall average among all women: 0-equal to or less than overall average, 1- greater than overall average.

Measurements of access to family planning information and services

We measured access to modern contraception by the total number of modern contraceptive methods reported by women in the cluster—the greater number of methods reported, the better the access. It is a proxy measurement based on an assumption that a specific contraceptive method is accessible to the cluster when at last one woman in this cluster reported use of this method. This assumption may not be true if some women obtained certain methods through special channels not available to the majority of women. It is also possible that some methods are available to the community but are not reported by any women.

We also measured the cluster-level exposure to family planning messages based on the percentages of women in the cluster who heard about family planning messages through television, radio, or newspapers. Lastly, we measured an aggregate level of women's contacts with family planning providers in the last 12 months.

Table 1. Operational definitions of individual, household, and community variables

Variables	Operational definition
Individual and household variables	
Age of woman	Self-reported age at time of survey: 15-24, 25-34, 35-44, 45-49 years
Woman's educational level	Highest level of education attained: none, primary, secondary or higher
Occupation	Current occupation: not-employed, agricultural or manual, professional/technical/managerial/clerical, sales and services
Religion	Rwanda-Catholic, Protestant and Adventist, Muslim and other;
	Nepal - Hindu, Buddhist, and Muslim/Kirat/Christian/Other
Parity	Number of living children the woman had: 0, 1-2, 3-4, 5+
Having a son	Having at least one son
Husband's education	Reported by wife: none, primary, secondary or higher
Husband's residency status	Lives in house, lives elsewhere for less than 1 year, and lives elsewhere for a year or longer
Household wealth quintile	Lowest, second, middle, fourth, and fifth
Community variables	
Socioeconomic development	
Region/province	Rwanda- Provinces: Kigali, South, West, North and East
	Nepal- development regions: Eastern, Central, Western, Mid-Western, Far-Western
Distance to a main road	Distance of cluster site to the nearest main road: 5km or less and >5km
Distance to a large city	Distance of DHS cluster point from its nearest populated settlement of 50,000 people or more: <10km, 10-19, 20-29, 30-39, 40-49km, 50+km
Low population density	Bottom 20% of clusters according to population density(people per square kilometers)
Female educational attainment	Average years of schooling among women in the cluster
Women's empowerment	
Women's experience of domestic violence	Percentage of women in the cluster who reported spousal physical or sexual violence
Women's participation in household decision-making	Percentage of women in the cluster who participated in household decision-making on woman's own health care
Women's participation in decision-making on family planning	Percentage of women in the cluster who participated in decision-making on using contraception
Fertility norms	
Average age at first marriage	Mean age at first marriage among women in the cluster
Longer interval between marriage and first birth	Mean interval between marriage and first birth is greater than the overall average
Fertility desire	Mean number of children desired by women in the cluster
Access to family planning information and services	
Access to modern contraception	Total number of modern contraceptive methods reported by women in the cluster
Exposure to family planning messages	Percentage of women in the cluster who are exposed to family planning messages through mass media (i.e., TV, radio, or newspaper)
Contacts with family planning providers	Percentage of women in the cluster who visited health facility for family planning or were visited by family planning providers in last 12 months

Individual variables

The multivariate analysis controls for the individual variables that may influence women's contraceptive use. These include the woman's age, education level, occupation, household wealth status, number of living children, religion, and husband's education, which all have been shown in the literature to be associated with use of family planning. All of these variables are specified as categorical variables in the models.

While the variables and reference groups are typically the same in both Rwanda and Nepal, the definitions of region/province and religion vary for each country. The analysis for Nepal includes two additional variables—whether the husband lives at home or has been away from home for less than one year, or for more than one year; and whether the respondent has at least one son, which is included to account for the effect of son preference.

2.2 Analysis Method

We use random-effects logit regressions for the multivariate analysis presented in this paper. DHS data follow a hierarchical structure—that is, individuals are nested within clusters, and clusters are nested within regions. Respondents who live in the same cluster or region may not be independent of one another. Compared with regular individual-level regression analyses that assume that all individuals are independent, the multilevel modeling approach accounts for the fact that people who live in the same area may have some characteristics in common. It should be noted women living in the same household are not independent. However this clustering effect is ignored in this analysis given it is not common that multiple women from a same household were interviewed.

While the outcome variable of this study—modern contraceptive use—is measured at the individual level, the predictors of most interest (community-level influences) are measured at the cluster level. Using the standard statistical approach, questions arise about the appropriate unit of analysis. Individual-level analysis ignores the nesting of people within clusters, which results in underestimating the standard errors and increasing the chance of incorrectly rejecting null hypotheses (Raudenbush & Bryk 2002). Alternatively, if the unit of analysis is the cluster, it becomes difficult to include individual-level variables in the analysis. These problems are addressed with multilevel modeling that allows for simultaneous investigation of the effects of the group-level and individual-level predictors on individual-level outcomes.

Another important feature of the random-effects model is that it gives information on the proportion of total variation that is explained by the cluster-level predictors. Random-effects models typically include a random intercept and/or random slopes. This analysis allows for random intercepts across clusters and assumes fixed effects of covariates across clusters.

The analysis is performed separately for Rwanda and Nepal. The model for each country can be expressed with two equations: one at the individual level and one at the cluster level.

At the individual level:

$$Log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \beta_{0j} + \beta_1 X_{ij} + r_{ij}$$

At the cluster level:

$$\beta_{oj} = \gamma_{00} + \gamma_{01} R_j + \mu_{oj}$$

$$\mu_{0j} \sim (0, \tau_{00})$$

Where p_{ij} is the fitted probability of using a modern contraceptive method for the ith individual in the jth cluster, X_{ij} is a column vector of individual-level variables, and R_j represents contextual variables at the cluster level. β_{oj} is a random intercept, which varies across clusters, and β_1 is a row vector of fixed coefficients for the predictors. μ_{oj} is the random component of the intercept and is assumed to be normally distributed with mean zero and variance τ_{00} . Significance of the random effect for cluster will indicate that the cluster-level predictors play a role after adjusting for individual-level variables.

In order to examine the variation in outcomes explained by different sets of variables, particularly the contribution of the four types of community-level influences in explaining the variation in women's contraceptive use, we examine six random-effects models sequentially, for each country, with different groups of variables included in each model. Model 1 includes only individual-level variables. Models 2-5 all have the individual-level variables, plus each of the four sets of community-level influences, in turn. Model 2 includes predictors for community socioeconomic development; Model 3 includes community-level variables for women's empowerment; Model 4 includes variables for community fertility norms; and Model 5 includes variables for community access to family planning information and services.

Model 6 is the complete model including all the individual-level and cluster-level variables considered. Given the high levels of sterilization in Nepal, one additional model is fitted for Nepal—Model 7, which is the same as Model 6 except that it is restricted to women whose current contraceptive method is not female sterilization or male sterilization. The sample size drops from 7,502 in Models 1-6 to 5,548 in Model 7, while the number of clusters remains the same. Table 2 gives a summary of the models for both countries.

Sampling weight is applied in both descriptive analysis and multivariate regressions.

Table 2. Random-effects regression models included in the analysis

	Variables in regression model
Model 1	Individual-level variables only
Model 2	Individual-level variables + Community socioeconomic development
Model 3	Individual-level variables + Community variables for women's empowerment
Model 4	Individual-level variables + Community fertility norms
Model 5	Individual-level variables + Community access to family planning information and services
Model 6	Individual-level variables + All community variables
Model 7 (only for Nepal)	All individual-level variables + All community variables (restricted to women who do not use sterilization as their current contraceptive method)

3 Results

3.1 Background Characteristics of Individuals and Clusters

Table 3 shows selected background characteristics of women included in the sample in each country (currently married women in rural areas who do not want, or are not sure if they want, a birth in the next two years). Slightly more than 60 percent of women are under age 35, in both countries. However, Nepal has a younger population, with one-quarter of women under age 25 compared with 15 percent in Rwanda.

A large majority of the women (72 percent) in Rwanda have a primary education, while only 7 percent have a secondary education, and 21 percent are not educated. In Nepal most women are not educated (51 percent), while 20 percent have a primary education, and 30 percent are educated at the secondary level or beyond. In both countries, agriculture or manual labor are the most common occupations among women, while 20 percent of women in Nepal are unemployed compared with only 8 percent in Rwanda.

Most women in Rwanda are either Catholic or other Christian, while Hinduism is the predominant religion in Nepal. Given that the analysis is restricted to women in rural areas, only a small percentage of women in either country live in households in the highest wealth quintile. Women in Rwanda are almost equally divided between those with 1-2, 3-4, or 5 or more living children, while few women have no children. In Nepal a smaller proportion of women have 5 or more children and a larger proportion have 1-2 children, compared with women in Rwanda.

Table 3. Background characteristic of currently married women in rural areas who did not want a child within two years

	Rwanda		Nepal	
	%	Number of women	%	Number of women
Age				
15-24	15.1	825	25.6	1,924
25-34	46.8	2,557	36.8	2,762
35-44	27.8	1,518	29.1	2,181
45-49	10.3	560	8.5	635
Education level				
No education	21.4	1,168	50.7	3,801
Primary	71.9	3,926	19.5	1,459
Secondary or higher	6.7	366	29.9	2,241
Occupation				
Unemployed	7.9	431	20.0	1,498
Agriculture/manual	87.1	4,755	69.3	5,202
Professional	4.7	257	2.7	205
Sales and service	0.3	17	8.0	597
Religion[1]				
Catholic (Hindu)	43.2	2,356	84.8	6,360
Christian (Buddhist)	53.8	2,939	8.4	631
Muslim/other (Muslim/kirat/Chris/other)	3.0	164	6.8	511

(Continued...)

Table 3. – *Continued*

	Rwanda		Nepal	
	%	Number of women	%	Number of women
Wealth quintile				
Lowest	21.0	1,146	19.9	1,490
Second	23.0	1,255	21.3	1,594
Middle	22.5	1,231	22.9	1,720
Fourth	22.0	1,200	21.0	1,578
Highest	11.5	629	14.9	1,120
Number of living children				
5+	30.4	1,660	12.0	904
3-4	32.5	1,775	35.4	2,652
1-2	33.8	1,844	45.0	3,374
none	3.3	181	7.6	571
Total	100.0	5,460	100.0	7,502

[1] Categories in parentheses are the main religions in Nepal

Table 4 describes background characteristics of the clusters included in the analysis sample, which includes 411 clusters in Rwanda and 194 clusters in Nepal all in rural areas. Most clusters in both countries are not far from a main road. In Rwanda 98 percent of the clusters are located within 5 km from a main road. Given such minimal variation in distance to a main road among the clusters, this variable is excluded from the multivariate analysis for Rwanda presented later. In Nepal overall access to main road is more difficult than in Rwanda, and 18 percent of the sampled clusters are located more than 5 km from a main road.

Poor access in Nepal is also reflected in the distance from a large city. In Nepal 41 percent of the clusters are located more than 40 km from a city with at least 50,000 people, versus 11 percent in Rwanda. In both countries the average level of women's education in the clusters is four years of schooling.

Among measures of women's empowerment, women's level of participation in decision-making both on their own health care and on family planning is high in both countries (see Table 4). Spousal violence is more prevalent in Rwanda than in Nepal. On average, 46 percent of women in a cluster in Rwanda compared with 15 percent in Nepal reported physical or sexual spousal violence.

For the community fertility norms, in Nepal women on average marry at age 17 compared with age 20 in Rwanda. Forty percent of the clusters studied in Rwanda and 38 percent in Nepal have a mean interval between marriage and first birth greater than the average among all clusters in the country. The average number of children desired among women in a cluster is higher in Rwanda, at 3.3 children, than in Nepal, at 2.2 children.

Although in both countries, on average, more than 60 percent of women in a cluster have access to family planning messages, fewer women have access to family planning services. In Rwanda 39 percent of women in a cluster reported visiting a health facility for family planning or being visited by a family planning provider. In Nepal, this percentage is much lower, at 19 percent, possibly because many women may have been sterilized.

In terms of the number of family planning methods used by women, in both countries, on average, women within any given sampled cluster reported having used three or four modern contraceptive methods (3.7 in Rwanda, and 4.2 in Nepal). Looking at the distribution of the clusters (data not shown), we find that Rwandan women in about 90 percent of the clusters have access to three or four modern methods. Women in 20 percent of the clusters reported access to five or more methods but very few (4 percent) reported six or seven methods. Women in Nepal have access to more methods. In 28 percent of the clusters included in the analysis in Nepal, women reported having access to five methods, and in 15 percent they reported six or seven modern methods.

Table 4. Description of community-level variables by percentage of clusters

Community-level variables	Rwanda (%)	Nepal (%)
Socioeconomic development		
Province/Development region[1]		
Kigali city (Eastern)	2.4	24.7
South (Central)	27.5	24.2
West (Western)	25.6	17.0
North (Mid-western)	18.5	19.6
East (Far-western)	26.0	14.4
Distance to a main road		
5km or less	98.3	72.0
more than 5km	1.7	18.0
Distance to a large city		
<10km	12.9	9.8
10-19km	32.9	20.1
20-29km	28.7	12.4
30-39km	14.1	17.0
40+ km	11.4	40.7
Low population density	20.0	20.0
Female educational attainment (mean)	4.0	3.9
Women's empowerment		
Women's experience of spousal physical or sexual violence	45.9	14.5
Women's participation in household decision-making	72.8	63.5
women's participation in decision-making on family planning	87.8	86.8
Fertility norms		
Average age at first marriage (mean)	20.5	17.3
Longer marriage to first birth interval	40.4	37.6
Average number of children desired by women (mean)	3.3	2.2
Access to family planning information and services		
Number of modern contraceptive methods reported by women (mean)	3.7	4.2
Percentage of women exposed to family planning messages	65.8	64.0
Percentage of women who had contacts with family planning providers	39.1	19.4
Total number of clusters	411	194

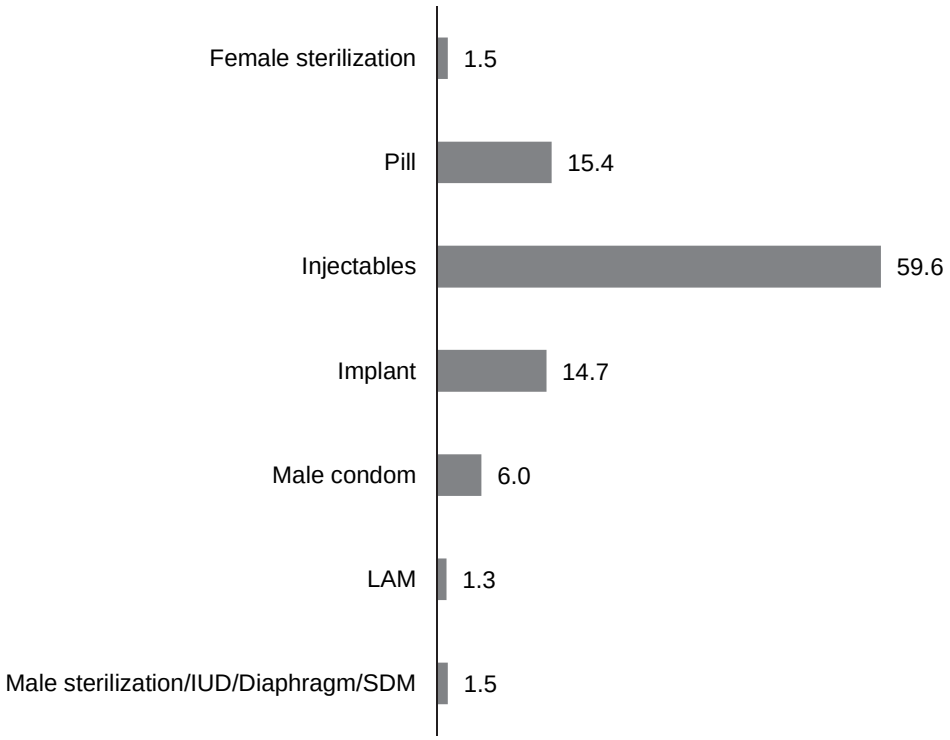
[1] Categories in parentheses are the development regions in Nepal

3.2 Contraceptive Prevalence and Method Mix

The contraceptive prevalence rate (CPR) is similar among women studied in Rwanda and Nepal. Among currently married women in rural areas who do not want a child within two years, 47 percent in Rwanda and 46 percent in Nepal are currently using modern contraception (Table 5). The method mix however differs substantially between the two countries. In Rwanda among modern method users, injectables are the most popular method (Figure 3), at 60 percent. Other methods used include the pill and implants (15 percent each), and male condom (6 percent). Use of permanent methods such as male and female sterilization is very low.

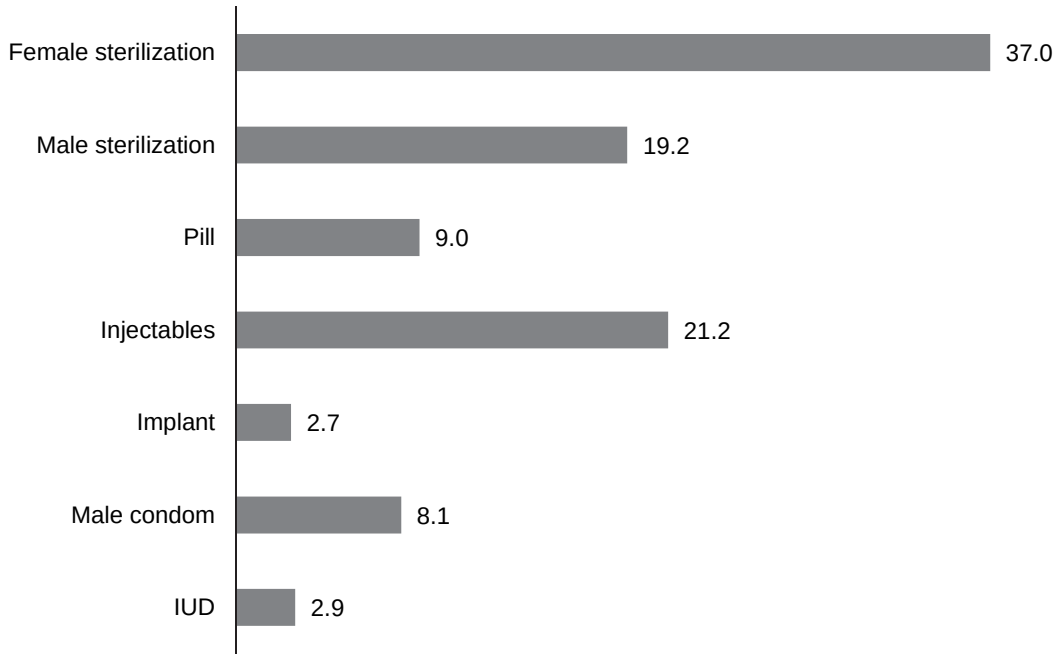
In contrast, in Nepal long-acting and permanent methods are popular (Figure 4). Female sterilization and male sterilization together account for 56 percent of all modern method use. Other methods used include injectables (21 percent), the pill (9 percent), and male condom (8 percent).

Figure 3. Percent distribution of women who currently use modern contraception, by type of method, Rwanda*



*This is the method mix among currently married women in rural areas who do not want a child within two years.

Figure 4. Percent distribution of women who currently use modern contraception, by type of method, Nepal*



*This is the method mix among currently married women in rural areas who do not want a child within two years.

3.3 Modern Contraceptive Use by Women's Background Characteristics

Table 5 presents the prevalence of modern contraceptive use by women's characteristics, among currently married rural women who do not want a child within two years. In Nepal, 63 percent of women age 35-44 and 53 percent of women age 45-49 use a modern method, reflecting the high levels of sterilization among women in Nepal. In Rwanda women's education is associated with contraceptive use, with 59 percent of women with secondary or higher education using contraception. In contrast, in Nepal the level of contraceptive use is highest among women with no education (53 percent) and lowest among women with secondary or higher education (37 percent). The popularity of sterilization among uneducated and less educated women in Nepal may contribute to this pattern.

In both countries women who are not employed have the lowest levels of contraceptive use. Women in professional occupations in Rwanda and women in sales and service occupations in Nepal have the highest levels of contraceptive use. Differences in contraceptive use by religion are small in both countries, except that in Nepal women belonging to religions other than Hindu/Buddhist are least likely to use contraception.

Overall, a positive relationship between wealth status and contraceptive use is evident in both countries. Also, in both countries women with three or four living children are most likely to be using modern methods. In Nepal, where son preference is the norm, more than half of the married women who have a son use a modern method compared with only 20 percent among women without a son. Not surprisingly, woman's husband being away from home is also associated with lower levels of modern contraceptive use.

Table 5. Prevalence of modern contraceptive use among currently married women in rural areas who do not want a child within two years, according to background characteristics

	Rwanda		Nepal	
	%	Number of women	%	Number of women
Age				
15-24	43.7	825	22.5	1,924
25-34	52.5	2,557	48.7	2,762
35-44	50.1	1,518	62.5	2,181
45-49	22.5	560	53.3	635
Education level				
No education	39.2	1,168	53.2	3,801
Primary	48.8	3,926	42.3	1,459
Secondary or higher	58.8	366	37.4	2,241
Occupation				
Unemployed	37.1	431	35.5	1,498
Agri/manual	48.1	4,755	48.7	5,202
Professional	51.5	257	41.4	205
Sales and service	47.4	17	55.5	597
Religion				
Catholic (Hindu)	50.8	2,356	47.5	6,360
Christian (Buddhist)	44.5	2,939	42.7	631
Muslim/other (Muslim/kirat/Chris/other)	50.1	164	36.6	511
Wealth quintile				
Lowest	40.2	1,146	38.5	1,490
Second	43.1	1,255	45.9	1,594
Middle	50.3	1,231	47.5	1,720
Fourth	52.1	1,200	49.2	1,578
Highest	54.7	629	51.8	1,120
Number of living children				
5+	43.0	1,660	49.3	904
3-4	52.7	1,775	61.4	2,652
1-2	50.8	1,844	39.7	3,374
None	1.8	181	11.3	571
Having a son				
No			20.3	1,584
Yes			53.4	5,918
Husband's residence status				
Lives in house			57.4	4,965
Lives elsewhere for less than one year			26.0	1,664
Lives elsewhere for one year or more			22.2	872
Total	47.4	5,460	46.4	7,502

3.4 Multilevel Analysis Results

Tables 6 and 7 present the results of multilevel analyses for Rwanda (Table 6) and Nepal (Table 7). As described earlier, in each table, Models I-5 present results of the individual-level variables and the different community-level predictors. Model 6 shows the effect of all variables included in the analysis. The analysis sample shown in these tables is currently married women in rural areas who do not want (or are not sure if they want) a birth in the two years after the survey. Given the high rates of sterilization in Nepal, Table 7 presents an additional model (Model 7) which is based on a smaller sample restricted to women in the analysis sample who are not sterilized and whose husbands are not sterilized.

In both tables, as we examine results presented across models, we look at the variation explained by different sets of variables, especially the contribution of cluster-level variables in explaining between-cluster variability in contraceptive use among sampled women. The intra-class correlation coefficient, rho, measures the proportion of variation in contraceptive use that is between clusters. The total variation can be partitioned into within-cluster variation and between-cluster variation. While individual-level variables explain within-cluster and between-cluster variation, cluster-level variables can explain only variation at the cluster level. As more cluster predictors are added to the model, rho is expected to move toward zero.

Rwanda

Individual and Household Characteristics

Multilevel analysis results in Rwanda indicate that, among currently married rural women who do not want a child in the next two years, women's age is negatively associated with modern contraceptive use, while women's education and household socioeconomic status have a positive association. These relationships remain consistent across all models even after taking into account the role of contextual effects. Women age 35 and older are less likely than women age 15-24 to use modern contraceptive methods. At the same time, women with secondary or higher education have one-and-a-half times the odds of using contraception compared with uneducated women (Model 6).

Likewise, women in the richest households are more likely to use modern methods compared with the poorest women. Women's employment in agriculture or as manual labor is also positively associated with contraceptive use as compared to unemployed women. The odds of Catholics using modern contraception are also higher compared with other Christians. Compared with women with 5 or more children, women with no children or 1-2 children are less likely to use contraception. However, there is little difference between women who have 3-4 children or 5 or more children. A rho of 0.07 for Model 1 indicates that the between-cluster variation accounts for 7 percent of the total variation in modern contraceptive prevalence.

Table 6. Results of multilevel modeling of modern contraceptive use among currently married rural women who do not want a child within two years, Rwanda

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual and household variables												
Age (ref.=15-24)												
25-34	0.94	0.77 - 1.14	0.92	0.76 - 1.11	0.94	0.77 - 1.14	0.91	0.75 - 1.11	0.93	0.77 - 1.13	0.91	0.75 - 1.11
35-44	0.76*	0.60 - 0.98	0.72**	0.56 - 0.92	0.77*	0.60 - 0.98	0.72**	0.56 - 0.92	0.75*	0.59 - 0.95	0.70**	0.55 - 0.90
45-49	0.20***	0.15 - 0.28	0.19***	0.14 - 0.27	0.20***	0.15 - 0.28	0.19***	0.14 - 0.26	0.21***	0.15 - 0.28	0.19***	0.14 - 0.27
Education level (ref.=none)												
Primary	1.13	0.97 - 1.32	1.08	0.93 - 1.26	1.13	0.97 - 1.32	1.11	0.95 - 1.29	1.11	0.95 - 1.29	1.08	0.93 - 1.26
Secondary or higher	1.54**	1.14 - 2.07	1.44*	1.07 - 1.93	1.55**	1.15 - 2.08	1.50**	1.12 - 2.02	1.51**	1.13 - 2.03	1.48**	1.10 - 1.99
Occupation (ref.=not employed)												
Agriculture/manual	1.44**	1.13 - 1.83	1.35*	1.06 - 1.71	1.43**	1.13 - 1.83	1.41**	1.11 - 1.79	1.36*	1.07 - 1.73	1.27*	1.01 - 1.60
Professional	1.36	0.95 - 1.96	1.29	0.89 - 1.85	1.37	0.95 - 1.98	1.38	0.96 - 1.98	1.30	0.90 - 1.86	1.31	0.91 - 1.88
Sales and service	1.14	0.39 - 3.32	1.09	0.38 - 3.14	1.15	0.40 - 3.35	1.15	0.40 - 3.30	1.08	0.37 - 3.14	1.13	0.40 - 3.19
Wealth (ref.=Poorest)												
Second	1.08	0.90 - 1.29	1.10	0.92 - 1.31	1.09	0.91 - 1.30	1.08	0.90 - 1.29	1.07	0.89 - 1.27	1.10	0.92 - 1.32
Middle	1.52***	1.26 - 1.82	1.53***	1.27 - 1.83	1.51***	1.26 - 1.82	1.49***	1.25 - 1.79	1.48***	1.24 - 1.78	1.50***	1.25 - 1.80
Fourth	1.65***	1.37 - 2.00	1.65***	1.36 - 1.99	1.66***	1.38 - 2.01	1.64***	1.36 - 1.97	1.57***	1.30 - 1.89	1.61***	1.33 - 1.94
Highest	1.72***	1.34 - 2.20	1.66***	1.29 - 2.13	1.74***	1.36 - 2.23	1.70***	1.33 - 2.17	1.55***	1.21 - 1.97	1.63***	1.27 - 2.09
Religion (ref.=Catholic)												
Christian	0.78***	0.68 - 0.88	0.81**	0.72 - 0.92	0.77***	0.68 - 0.87	0.79***	0.69 - 0.89	0.78***	0.69 - 0.89	0.81***	0.72 - 0.91
Muslim/other	0.95	0.67 - 1.35	0.98	0.69 - 1.38	0.94	0.66 - 1.33	0.94	0.66 - 1.33	0.94	0.66 - 1.32	0.93	0.66 - 1.31
Number of living children (ref.=5+)												
3-4	1.06	0.89 - 1.25	1.03	0.87 - 1.22	1.06	0.90 - 1.25	1.03	0.87 - 1.21	1.05	0.89 - 1.24	1.01	0.86 - 1.20
1-2	0.86	0.71 - 1.05	0.83	0.68 - 1.01	0.86	0.71 - 1.05	0.80*	0.66 - 0.98	0.85	0.70 - 1.04	0.80*	0.66 - 0.97
None	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04	0.01***	0.00 - 0.04
Husband's education (ref.=None)												
Primary	1.16	1.00 - 1.35	1.15	0.99 - 1.34	1.16	1.00 - 1.35	1.14	0.98 - 1.33	1.16	1.00 - 1.35	1.14	0.98 - 1.33
Secondary or higher	1.06	0.82 - 1.37	1.04	0.80 - 1.35	1.06	0.82 - 1.38	1.03	0.80 - 1.34	1.07	0.83 - 1.39	1.05	0.81 - 1.36

(Continued...)

Table 6. – *Continued*

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Contextual variables												
Socioeconomic development												
Provinces (ref.=Kigali City)												
South			1.28	0.80 - 2.05							1.34	0.87 - 2.04
West			0.70	0.43 - 1.13							0.84	0.55 - 1.30
North			1.27	0.79 - 2.05							1.34	0.88 - 2.06
East			1.11	0.68 - 1.81							1.16	0.75 - 1.79
Distance to large city (ref.=<10km)												
10-19km			0.98	0.77 - 1.25							1.05	0.85 - 1.30
20-29km			1.15	0.89 - 1.48							1.20	0.96 - 1.51
30-39km			1.16	0.86 - 1.57							1.16	0.88 - 1.53
40+km			0.98	0.68 - 1.41							1.19	0.85 - 1.68
Low population density			0.67***	0.54 - 0.84							0.71**	0.58- 0.86
Women's average years of education			1.08*	1.02 - 1.16							0.99	0.92 - 1.06
Women's empowerment												
Women's participation in household decision-making on health care					0.79	0.52 - 1.19					0.81	0.57 - 1.17
Women's participation in decision-making on family planning use					2.19**	1.26 - 3.78					2.34***	1.46 - 3.75
Women's experience of spousal violence					0.86	0.62 - 1.20					0.94	0.71 - 1.25
Fertility norms												
Average ideal number of children							0.60***	0.52 - 0.70			0.73***	0.63 - 0.84
Average age at first marriage							1.03	0.98 - 1.09			1.01	0.95 - 1.07
Longer marriage to first birth interval							1.24**	1.07 - 1.44			1.17*	1.03 - 1.34

(Continued...)

Table 6. – *Continued*

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Access to family planning information and services												
Exposed to family planning messages									1.40	0.89 - 2.21	1.11	0.70 - 1.75
Contact with family planning providers									1.69	0.95 - 2.99	1.61	0.95 - 2.73
Number of family planning methods reported									1.35***	1.26 - 1.45	1.32***	1.24 - 1.41
rho	0.070		0.045		0.066		0.052		0.042		0.012	

*p<0.05 **p<0.01 *** p<0.001

Contextual effects

Among the contextual effects in Rwanda, the level of development in the community where women reside affects their use of contraception. Before incorporating other contextual effects, women in clusters with low population density are less likely than others to use modern methods, while women in clusters with a higher level of women's education are more likely to do so (Model 2).While the population density remains significant, the effect of education disappears when all contextual factors are taken into consideration (Model 6). One key aspect defining women's empowerment—the level of women's ability to make decisions regarding family planning in the cluster (Model 3)—has a statistically positive association with contraceptive use. After controlling for all other individual and community-level characteristics, we find that residence in a community with a higher percentage of women making decisions on family planning is a key characteristic that remains statistically significant with a strong positive effect (Model 6).

With regard to the influence of community fertility norms, while the mean age of women at first marriage in the community of residence in Rwanda does not influence contraceptive use among our sample of women, the mean number of children desired by women in the community does have an influence. Women studied who live in communities with a greater average number of children desired are less likely to use modern methods (Model 4). Moreover, residing in a community with a longer gap between marriage and first birth also increases the likelihood of contraceptive use for women in our sample. These relationships hold strong even after taking into account all other effects in Model 6.

Model 5 examines the relationship between the community's access to modern contraception, family planning messages, and contacts with family planning providers and women's contraceptive use. In Rwanda contraceptive use is higher among women in communities with a greater contraceptive method mix compared with other communities. The role of the indicators of family planning information and contact with family planning providers is not statistically significant.

Based on the rho for each model, we also measure the contributions of contextual factors to between-cluster variations in contraceptive use. In Model I, with only individual-level variables, about 7 percent of the total variation in contraceptive use is between clusters. This proportion decreases in Models 2-5 as various groups of contextual factors are added to the analysis. When all the contextual variables are included (Model 6), the between-cluster variation only accounts for 1 percent of the total variation in contraceptive use. This means about 83 percent (1-.012/0.7) of the unobserved heterogeneity in contraceptive use at the cluster level is explained by the contextual variables analyzed. The reduction in rho is greater in Model 2 and Model 5, which indicates the variables on socioeconomic development and access to family planning information and services explain more between-cluster variation than the other two groups of variables (Models 3 and 4).

Overall in Rwanda, our analysis finds that contextual effects influence use of contraception among women in the study sample. As indicated above, specific characteristics of communities where Rwandan women reside affect their use of modern methods. The decline in rho in successive models demonstrates the increase in between-cluster variation that is explained by the addition of these variables to the regression models. Relatively, socioeconomic development and access to family planning services play a bigger role than the community gender and fertility norms.

Nepal

<u>Individual and household characteristics</u>

As in Rwanda, the multilevel analysis results for Nepal in Table 7 indicate that the odds of modern contraceptive use vary according to women's age (Model 1 and Model 6). The odds of using modern contraceptives are lowest among women age 15-24 and are highest among women age 35-44. The picture is somewhat different when the analysis is restricted to women who did not report using male or female sterilization (Model 7). We find that women age 45-49 are the least likely to use modern contraception, while women age 25-34 are more likely to use contraception than women age 15-24. The uptake of contraceptive use among women age 35-44 is not statistically different from women age 15-24.

Model 6 also indicates that the effect of women's education is negative, while the role of household wealth is positive. The odds of using a modern method are closely related to the number of living children a woman has. Relative to women with 5 or more children, women with 1-2 or 3-4 living children are more likely to use a modern method; in fact women with 3-4 living children have almost twice the odds of using modern contraception compared with women with 5 or more children (Model 6). Women with no living children are least likely to use contraception. But when the analysis is based on the sample of women without male or female sterilization (Model 7), there is no difference by education or household wealth. Also, the difference between women with 1-2, 3-4, and 5 or more children is eliminated. These findings are possibly because of the popularity of sterilization for contraception among less educated women and women in households of lower socioeconomic status.

Occupation has some effect on contraceptive use in Nepal; women who are not employed are least likely to use modern methods. The odds of modern method use are greatest among women in agricultural or manual occupations. The odds also are greater among women belonging to the dominant religion, Hinduism, compared with other religions.

While husband's education has little effect on women's use of contraception, with Nepal's high levels of spousal separation the fact that husbands live at home matters. The odds of contraceptive use among women with husbands who have lived away from home for more than one year are only 17 percent the odds of contraceptive use among women with husbands who live at home. Son preference is also reflected in the study results. Having a son increases the likelihood of contraceptive use considerably (odds ratio is 2.6 in Model 6). Among women who did not report sterilization, the effect is weaker but the odds of using a modern method are still 1.7 times those of women without a son (Model 7).

Table 7. Results of multilevel modeling of modern contraceptive use among currently married rural women who do not want a child within two years, Nepal

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual and household variables														
Age (ref.=15-24)														
25-34	1.92***	1.62 - 2.26	1.97***	1.66 - 2.32	1.93***	1.63 - 2.28	1.93***	1.63 - 2.28	1.92***	1.62 - 2.26	2.00***	1.70 - 2.37	1.26*	1.04 - 1.54
35-44	2.67***	2.19 - 3.25	2.78***	2.28 - 3.38	2.71***	2.23 - 3.31	2.66***	2.18 - 3.24	2.67***	2.19 - 3.25	2.80***	2.30 - 3.41	1.26	0.98 - 1.62
45-49	1.42**	1.09 - 1.83	1.50**	1.15 - 1.94	1.44**	1.11 - 1.87	1.41**	1.09 - 1.83	1.41**	1.09 - 1.83	1.51**	1.17 - 1.96	0.36***	0.25 - 0.52
Education level (ref.=none)														
Primary	0.81*	0.69 - 0.95	0.83*	0.71 - 0.98	0.82*	0.70 - 0.96	0.80**	0.68 - 0.94	0.81**	0.69 - 0.95	0.81*	0.69 - 0.95	0.84	0.68 - 1.04
Secondary or higher	0.75**	0.62 - 0.89	0.78**	0.65 - 0.93	0.75**	0.63 - 0.90	0.74***	0.62 - 0.88	0.74***	0.62 - 0.88	0.76**	0.64 - 0.91	1.12	0.90 - 1.40
Occupation (ref.=not employed)														
Agriculture/manual	1.90***	1.61 - 2.24	1.93***	1.64 - 2.28	1.91***	1.62 - 2.25	1.83***	1.55 - 2.16	1.87***	1.58 - 2.20	1.82***	1.55 - 2.15	1.90***	1.53 - 2.35
Professional	1.31	0.90 - 1.89	1.30	0.90 - 1.88	1.32	0.91 - 1.90	1.29	0.90 - 1.87	1.30	0.90 - 1.89	1.33	0.92 - 1.92	1.56*	1.02 - 2.39
Sales and service	1.65***	1.30 - 2.09	1.69***	1.33 - 2.14	1.65***	1.30 - 2.09	1.64***	1.30 - 2.08	1.64***	1.29 - 2.07	1.68***	1.33 - 2.13	1.66***	1.24 - 2.21
Wealth (ref.=Poorest)														
Second	1.43***	1.19 - 1.72	1.38***	1.15 - 1.67	1.46***	1.21 - 1.76	1.43***	1.19 - 1.72	1.43***	1.19 - 1.72	1.36**	1.13 - 1.63	1.05	0.84 - 1.32
Middle	1.75***	1.43 - 2.15	1.65***	1.34 - 2.02	1.83***	1.49 - 2.24	1.77***	1.45 - 2.16	1.76***	1.44 - 2.16	1.69***	1.39 - 2.07	1.14	0.89 - 1.46
Fourth	2.08***	1.66 - 2.61	1.86***	1.47 - 2.35	2.18***	1.73 - 2.74	2.08***	1.66 - 2.61	2.08***	1.66 - 2.61	1.89***	1.50 - 2.38	1.16	0.87 - 1.54
Highest	2.18***	1.66 - 2.88	1.82***	1.36 - 2.43	2.31***	1.74 - 3.06	2.24***	1.70 - 2.95	2.19***	1.65 - 2.89	1.96***	1.47 - 2.60	1.38	0.98 - 1.94
Religion (ref.=Hindu)														
Buddhist	0.82	0.65 - 1.03	0.79*	0.63 - 1.00	0.82	0.66 - 1.04	0.85	0.68 - 1.07	0.81	0.65 - 1.02	0.79*	0.63 - 0.99	1.26	0.98 - 1.64
Muslim/kirat/Chris/other	0.68**	0.53 - 0.88	0.72**	0.56 - 0.92	0.67**	0.52 - 0.86	0.75*	0.58 - 0.96	0.69**	0.53 - 0.88	0.74*	0.58 - 0.94	1.55**	1.16 - 2.09
Number of living children (ref.=5+)														
3-4	1.90***	1.59 - 2.28	1.93***	1.61 - 2.31	1.92***	1.60 - 2.30	1.90***	1.58 - 2.28	1.90***	1.59 - 2.28	1.94***	1.62 - 2.32	1.00	0.79 - 1.28
1-2	1.26*	1.03 - 1.55	1.28*	1.04 - 1.57	1.28*	1.04 - 1.57	1.25*	1.02 - 1.55	1.26*	1.02 - 1.55	1.27*	1.03 - 1.56	0.93	0.70 - 1.22
None	0.58**	0.40 - 0.86	0.59**	0.40 - 0.87	0.60**	0.40 - 0.88	0.59**	0.40 - 0.87	0.58**	0.40 - 0.86	0.59**	0.40 - 0.88	0.28***	0.18 - 0.44
Husband's education (ref.=None)														
Primary	0.87	0.74 - 1.02	0.90	0.76 - 1.06	0.87	0.74 - 1.03	0.85	0.72 - 1.00	0.86	0.73 - 1.01	0.87	0.73 - 1.02	0.85	0.68 - 1.06
Secondary or higher	1.11	0.94 - 1.32	1.17	0.99 - 1.39	1.11	0.94 - 1.32	1.08	0.91 - 1.28	1.09	0.92 - 1.30	1.14	0.96 - 1.35	1.14	0.91 - 1.43
Husband 's residency status (ref.=living in home)														
Away for <1 year	0.25***	0.22 - 0.29	0.25***	0.22 - 0.29	0.25***	0.22 - 0.29	0.25***	0.21 - 0.29	0.25***	0.22 - 0.29	0.26***	0.22 - 0.30	0.17***	0.14 - 0.20
Away for 1+ year	0.16***	0.13 - 0.20	0.17***	0.14 - 0.20	0.16***	0.14 - 0.20	0.17***	0.14 - 0.20	0.17***	0.14 - 0.20	0.17***	0.14 - 0.21	0.03***	0.02 - 0.04
Having a son	2.63***	2.20 - 3.14	2.61***	2.18 - 3.12	2.62***	2.19 - 3.13	2.62***	2.19 - 3.13	2.62***	2.19 - 3.14	2.59***	2.17 - 3.10	1.67***	1.37 - 2.03

(Continued...)

Table 7. – *Continued*

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Contextual variables														
Socioeconomic development														
Development region (ref.= Eastern)														
Central			2.75***	2.14- 3.53							1.91***	1.50 - 2.44	0.97	0.74 - 1.28
Western			1.29*	1.00 - 1.67							0.85	0.66 - 1.10	0.58***	0.44 - 0.77
Mid-western			1.67***	1.24 - 2.25							0.93	0.70 - 1.26	0.73	0.54 - 1.02
Far-Western			2.04***	1.47 - 2.86							0.94	0.67 - 1.33	0.84	0.59 - 1.23
Distance to main road (ref.= <5km)														
5+ km			1.08	0.85 - 1.38							1.03	0.83 - 1.28	1.29	0.93 - 1.61
Distance to large city (ref.=<10km)														
10-19km			0.97	0.73 - 1.29							0.88	0.769 - 1.13	0.64**	0.49 - 0.83
20-29km			1.15	0.82 - 1.62							1.11	0.863- 1.49	0.57**	0.41 - 0.78
30-39km			0.67*	0.48 - 0.94							0.61**	0.45 - 0.81	0.44***	0.32 - 0.61
40+km			0.64**	0.47 - 0.88							0.63**	0.48-0.83	0.38***	0.28 - 0.52
Low population density			1.29	0.94 - 1.77							1.25	0.95 - 1.66	1.24	0.92 - 1.69
Women's average years of education			1.07*	1.00 - 1.13							1.04	0.96 - 1.12	1.01	0.92 - 1.10
Women's empowerment														
Women's participation in household decision-making on health care					0.76	0.40 - 1.45					0.30***	0.16 - 0.57	0.24***	0.12 - 0.49
Women's participation in decision-making on family planning use					2.40	0.99 - 5.84					2.12*	1.05 - 4.25	3.29**	1.50 - 7.22
Women's experience of spousal violence					2.14	0.94 - 4.86					1.47	0.75 - 2.90	1.02	0.49 - 2.10
Fertility norms														
Average ideal number of children							0.45***	0.32 - 0.61			0.34***	0.23 - 0.51	0.47**	0.30 - 0.74
Average age at first marriage							0.74***	0.67 - 0.82			0.78***	0.71 - 0.87	0.90	0.81 - 1.01
Longer marriage to first birth interval							0.81	0.65 - 1.02			0.98	0.80 - 1.19	1.06	0.85 - 1.32
Access to family planning information and services														
Exposed to family planning message									0.66	0.41 - 1.07	0.64	0.38 - 1.08	2.13*	1.19 - 3.83
Contact with family planning providers									1.19	0.46 - 3.10	2.42*	1.08 - 5.41	6.33***	2.63 - 15.24
Number of family planning methods reported									1.17***	1.08 - 1.27	1.15***	1.07 - 1.23	1.28***	1.18 - 1.38
rho	0.102		0.064		0.095		0.08		0.093		0.033		0.019	

*p<0.05 **p<0.01 *** p<0.001

The analysis sample for model 1-6 is currently married women in rural who do not want (or are not sure if they want) a child within 2 years

In model 7, women who currently use male and female sterilization are excluded

Contextual effects

Selected contextual factors show an influence on women's use of modern methods in Nepal. The level of development of the community where women reside in Nepal has a bearing on their contraceptive use shown in both Model 2 and Model 6. Controlling for all variables in Model 6, the odds of using contraception are higher among women in the Central region compared with the Eastern region. This is in line with the patterns reported among all women in the 2011 Nepal DHS report that indicate that the use of a modern method is highest in the Central region, a region with the highest socioeconomic status in the country. Modern method use among the sampled women is lowest in the Eastern region in Nepal, where socioeconomic status of the population is relatively lower. While residence in a cluster with a high level of women's education is significant in Model 1, its role is eliminated when we take into account the role of all individual and community-level characteristics in Model 6. Unlike the case of Rwanda, population density has little role to play in use of modern contraception, but proximity to a large city is relevant (Model 6). Removing all women who use sterilization from the analysis sample, the main indicator that remains relevant is distance from the city (Model 7); the odds of contraceptive use steadily diminish with an increase in proximity to a large city.

The two key aspects defining women's empowerment that influence contraceptive use in Nepal among the women sampled are the community level of women's decision-making about health and family planning (Model 6). After controlling for all other characteristics, results indicate that residence in a community with a high level of women's decision-making on health care has a negative effect on contraceptive use among the study sample, while the effect of residence in a cluster with a higher percentage of women's decision-making on family planning is positive. Similar effects are evident among women who reported a non-sterilization method (Model 7).

With regard to fertility norms in Nepal, a strong negative relationship between the mean number of children desired among women in the community and contraceptive use among the study sample is evident (Model 4). Living in a community where there is a greater desire to have more children is associated with lower use of modern contraceptive methods. A similar negative relationship with community mean age at first marriage and contraceptive use among women in the study sample is also observed. In communities where the mean age at first marriage is higher, the likelihood of women using modern contraception tends to be lower. Both relationships remain consistent even after controlling for all individual and contextual characteristics (Model 6). However, when we restrict the analysis to women who reported that they did not use sterilization for contraception, only the role of desired number of children remains significant (Model 7).

In Nepal, contraceptive use is higher among women in communities with a greater method mix of contraceptives compared with women in other communities (Models 5-7). Community access to family planning services measured in terms of contact with family planning providers also bears a positive relationship to use of modern methods in the complete models (Models 6 and 7). Among women in the study sample who do not use a permanent contraceptive method, such as male or female sterilization, the role of community access to family planning services is significantly higher (6.33). Furthermore, residence in communities with greater exposure to family planning messages also has a positive effect on contraceptive use in Model 7.

Overall, after taking into account contextual variables, the between-cluster variation drops in all successive models. Controlling for all contextual effects brings the rho down to 3 percent in Model 6, which means 69% (1-.032/ .102) of the variation between clusters is explained by the contextual variables. Comparing Models 2-5, socioeconomic development variables and access to family planning services variables explain more cluster-variation than the other two groups of variables.

4 Discussion

This study analyzed contextual determinants of modern contraceptive use in two culturally different settings, Rwanda and Nepal, with a primary interest in four spheres of community-level influences—socioeconomic development, women's empowerment, fertility norms, and access to family planning information and services.

The focus of the study was on a subset of women of particular interest to family planning programs: rural women who do not wish to have a child within the next two years. We limited the study to rural women because they may face unique barriers to contraceptive use, such as geographic remoteness and lack of contraceptive options. The study was also limited to women who do not wish to have a child right away because these are women who need effective contraception and who are of great interest to family planning programs.

In both Nepal and Rwanda our study found that socioeconomic development significantly affects use of modern contraception among rural women who do not want to have a child in the next two years. Among the measures of the community's socioeconomic development, in Nepal we found evidence that the distance from a large city, a measure of geographic remoteness, is inversely associated with women's contraceptive use. This pattern is particularly strong among rural women who are not using female or male sterilization and who do not want a child in the next two years, even after adjusting for other individual and contextual factors (Model 7 in Table 7). This finding highlights the particular challenges of Nepal's mountainous topography and points to the need for family planning programs to continue to seek new ways to make contraception available and accessible in the most remote parts of the country.

Similarly, in both countries community-level indicators of women's access to family planning information and services are associated with contraceptive use among women in the study sample. In both countries women living in communities with better access to modern contraceptive methods (measured by the total number of methods reported by women in the cluster) are more likely to use modern methods of contraception. This finding is in line with what the literature has shown—that easy access to a wide range of contraceptive methods results in a more balanced method mix and higher levels of contraceptive prevalence (Roser, 2002). A study based on the linked DHS and SPA data in four African countries (Rwanda, Kenya, Uganda, and Tanzania) found that regional variation in contraceptive use is significantly associated with regional differences in family planning service availability and the service environment at health facilities (Wang et al., 2012).

Contact with family planning providers is important for women to receive family planning information and counseling about adopting a contraceptive method. We found that the community-level contact with family planning providers is significantly associated with modern contraceptive use in Nepal, but not in Rwanda.

In Nepal the level of contact with family planning providers is low; in an average cluster less than 20 percent of the women in the cluster visited or were visited by a family planning provider in the last 12 months. This is partially due to the common use of female sterilization and male sterilization, which typically do not require women to visit health facilities. Despite the low level of contact with family planning providers in the communities in Nepal, such contact is strongly associated with use of modern contraception. The effect is even stronger for non-sterilization users. In Nepal female community health workers and reproductive health volunteers are the two types of health providers visiting women in the field. The findings from the analysis in Nepal highlight the importance of contact with family planning providers for women in rural Nepal to adopt reversible modern methods.

Women's empowerment is usually believed to be associated with their ability and behavior to seek health services. Among the indicators of women's empowerment, community norms about women's involvement in family planning decisions appear to have an important positive effect on individual women's contraceptive use, in both Rwanda and Nepal. Enabling women to make decisions about family planning and contraceptive use is critical to the use of contraception.

We also found evidence that community-level fertility norms are important determinants of women's decision to use contraception. Previous research has shown that the number of children desired by women is associated with their contraceptive use. Our analysis shows that the number of children desired among others in the community also affects use of contraception among women in the study sample. In both countries studied, women living in communities where most people want to have more children are significantly less likely to be currently using modern contraception. Family planning programs in Nepal and Rwanda both have sought to encourage people to have small families, and these efforts have shown an impact. In Rwanda in particular, women's desired number of children has decreased substantially over the past decade, from 5.0 in 2000 to 3.6 children in the 2010 DHS.

Given the methodological challenges to analyzing community-level factors, it is worth commenting on the analysis used in this study, which is based on data from the most recent DHS surveys linked to spatial data from a variety of sources in Rwanda and Nepal. Aggregating responses of individuals living in the same area is one way to obtain measurements for small geographic units such as communities. Since DHS surveys randomly select clusters and then households within the selected clusters, and finally all women age 15-49 in selected households, the aggregation of indicators for individuals in the cluster acts as a good proxy for the cluster's characteristics. For example, it is fairly safe to say that a community has an educated population if the average years of schooling of the interviewed individuals in that community are high. In this analysis, aggregated cluster-level indicators provide meaningful information regarding the context in which the surveyed women live. We also took advantage of the availability of spatial variables from a variety of sources and linked them to the DHS cluster locations with GIS software.

Nevertheless, limitations associated with using some proxy variables in the analysis need to be acknowledged. For example, the community access to modern contraception is measured by the total number of modern methods reported by women in the cluster. It is a proxy measurement based on an assumption that a specific contraceptive method is accessible to the cluster when at least one woman in that cluster reported use of the method. Access to contraceptive methods would be overestimated if some women obtained certain methods through special channels that are not available to the majority of women. Considering our focus on the clusters in rural areas, this may not happen that often. Access could be underestimated if some methods are available to the community but are not used by any women, for one reason or another, and therefore not reported.

Another contextual variable—the percentage of women in the cluster who visited a health facility for family planning or were visited by family planning providers in the last 12 months—may not precisely measure access to services, because method choice could affect women's visits to health facilities. Women who use long-term method (IUDs, implants, and sterilization) need less-frequent visits to providers compared with women who use short-term methods (pills, injectables, and condoms). The effect of access would be underestimated if many women rely on long-term methods, which is the case in Nepal where more than half the modern contraceptive users reported using long-term methods. Indeed, after we exclude the women who reported female or male sterilization as their method (Model 7), the effect of this variable becomes stronger, as reflected by an increase in the odds ratio from 2.4 to 6.3. We expect the underestimation to be minimal in Rwanda, where women predominantly reported using short-term contraceptive methods.

Overall, results from this study indicate the relevance for family planning programs of the community context in which women live. The demand for family planning services is influenced not only by women's individual and household socioeconomic characteristics, but also by the community's socioeconomic development, its access and exposure to family planning, the gender norms of local community members regarding decision-making for family planning and health issues, and community norms regarding marriage and childbirth. As this study has shown, based on an analysis of Rwanda and Nepal, the role of these contextual characteristics also is not necessarily consistent across countries. In general, among the factors we explored, those relevant to socioeconomic development and access to family planning services seem to play a bigger role in affecting women's contraceptive behaviors than do community gender and fertility norms. Furthermore, in countries such as Nepal with high levels of male migration and son preference, there is a greater need for family planning programs to take into account the nature of the demand for contraceptive services among women, based on their circumstances.

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