Demand and Unmet Need to Space Births in Rwanda: A Two-Step Analysis of Determinants

Dieudonné Ndaruhuye Muhoza[1], Annelet Broekhuis[2] and Pieter Hooimeijer[3]

Abstract

Rwanda has recently experienced impressive success in family planning, leading to less unmet need and a lower fertility rate. Despite this achievement, unmet need remains a demographic and health issue. Because the interval between births has a strong effect on infant and maternal morbidity and mortality and because long intervals lead to a further fertility decline, this study seeks to identify the barriers to the use of contraceptives by women who want to space births. The study uses a pooled dataset from the 2005 and 2010 RDHS which enables an assessment of changes in both demand for and use of family planning. In order to take into account the latent demand in the analysis of unmet need, we applied the Heckman probit model that simultaneously estimates two probit equations: one for demand, another for unmet need. The results show that the demand to postpone the next birth is correlated with desired family size, the health status of the index child and the experience of infant mortality. Socio-economic factors have a limited role in the demand for spacing. The level of unmet need has dramatically declined between 2005 and 2010, especially among women with less education and cultivators. Bio-demographic factors, such as being in amenorrhea, and cultural factors, especially religious attitudes, still hamper the use of contraception. The strong commitment of the government to reproductive health may have been the main factor in increasing the uptake of contraception. To further increase contraceptive prevalence, continued advocacy is needed.

Keywords

Unmet need; family planning; birth spacing; Heckman probit model; Rwanda

Introduction

Rwanda has recently experienced an impressive success in family planning (National Institute of Statistics of Rwanda (NISR), Ministry of Health (MoH) & ICF International, 2012; Westoff, 2013). The contraceptive prevalence rate has tripled from 17% in 2005 to 52% in 2010. As a consequence, unmet need for family planning has been halved from 37% to 19%, and the total fertility rate (TFR) declined from 6.1 to 4.6 births. Despite this achievement, unmet need remains a matter of concern; actual fertility is still higher than the average ideal family size of 3.6 births and, more importantly, the current median birth interval of 32.7 months is substantially lower than the preferred median interval of nearly 54 months. Moreover, the gap between the current and ideal median birth interval is widening: in 2005 these indicators were 31.3 and 45.0 months respectively. Short birth intervals can be harmful to the health and nutritional status of children, exposes mothers to greater risks of pregnancy

[1] Department of Applied Statistics, University of Rwanda, Rwanda. Email: dieumu_res@yahoo.fr
[2] Department of International Development Studies, Utrecht University, The Netherlands
[3] Department of Human Geography and Urban Planning, Utrecht University, The Netherlands

complications, and is associated with high cumulative fertility (Gipson, Koening & Hindin, 2008; Rutstein, 2003; Conde-Agudelo & Belizan, 2000).

Reproductive health programs that facilitate women to meet their spacing desires may therefore contribute to lower infant and maternal mortality or morbidity and to the achievement of some of the Millennium Development Goals by the Rwandan government (USAID-Rwanda, 2008; Singh, Sedgh & Hussain, 2010; Rafalimanana & Westoff, 2000). The achievement of effective reproductive planning is expected also to be helpful for Rwanda in other ways. It can contribute to improving living conditions in this poor and highly densely populated country (400 people per sq.km) by slowing down population growth both in the short and long run and by accelerating development. When more women are able to space their births according to their desire, it will also lower demand for limiting births as it takes a longer time to achieve the desired number of children. Rafalimanana and Westoff (2000) found that if preferred intervals were realized, the TFR in Rwanda could potentially decline by one third compared to its level in 1998.

To further target this issue, one needs to identify barriers to the use of contraceptives by women who want to postpone the next pregnancy. Most studies that examine the driving factors of the demand for family planning and the level of unmet need (Ojakaa, 2008; Westoff, 2001) treat these two concepts separately, restricting the analysis of unmet need to those who express the desire to postpone births. From a methodological point of view, this might cause sample selection bias. To some extent, the same factors that drive demand will also influence the decision to use contraceptives to satisfy that desire. Ignoring those who do not have an explicitly stated demand might underestimate the levels of unmet need. From a substantive point of view, restricting the analysis to manifest demand ignores the latent demand that is important to address when further up-scaling reproductive health programs. Thus, both demand and unmet need must be analyzed simultaneously.

The objective of this article is to identify the factors that still sustain the unmet need for spacing among Rwandan women after the introduction of the successful family planning program, while including the latent demand for reproductive services. Using a combined dataset from the Rwandan Demographic and Health Surveys (RDHS) 2005 and 2010 we show which factors have become less strong and which are still pertinent in explaining unmet need in 2010. By applying a Heckman probit model, we include latent demand in the selection model and unmet need in the outcome model.

Socio-cultural Aspects of Birth Spacing in Rwanda

Despite the existence of short intervals, better planned births have been a concern of Rwandan women for a long time. Shorter intervals were judged to hamper the health of infants and toddlers. Women with close births are blamed by the community and receive a pejorative qualification (*Umugore w'indahekana* in Rwandan language), meaning women with births too close to 'back' the younger sibling. Thus mothers are held responsible for the poor health status of their babies (Ilinigumugabo, 1989). The desire for long intervals has been confirmed by the four consecutive Demographic and Health Surveys (DHS). In 1992 the first Rwanda DHS revealed a median preferred interval of 47 months while the achieved interval was only 33 months (Office National de la Population (ONAPO), 1994). The 2010 RDHS reports a median preferred interval of 54 months while the actual interval is still 33 months. Seeing the preference for long birth intervals and the cultural values that support a reproductive attitude to achieve these long and healthier intervals, one could expect that the

demand for spacing should be met more easily now that family planning methods have improved substantially. This raises the question of which barriers still exist in 2010.

For a long time, the Rwandan family planning programs have focused more on birth limitation (NISR & ORC Macro, 2006, p.4; May, 1995, p.330) than on birth spacing, which—in the context of an overpopulated agrarian country—makes some sense. Even today, birth spacing is less emphasized during sensitization and advocacy campaigns. Crystal (2008) has shown that in Rwanda few women associate close births with maternal health risks and many are unaware that using contraception could extend the time between two consecutive births. Instead, people believe that the use of contraception aims exclusively at family limitation. The current reproductive health program does link birth spacing to health outcomes by integrating family planning with immunization programs. Yet, the discrepancy between preferred and actual intervals persists after the introduction of the more recent family planning programs, requiring a better insight into unmet need.

Factors Driving the Demand and Unmet Need for Birth Spacing

Unmet need is defined as not using contraception despite the desire to postpone the next pregnancy. It includes pregnant and postpartum amenorrheic women whose pregnancy or last birth was mistimed, fecund women who are neither pregnant nor postpartum amenorrheic who are not using any method of family planning and say they want to wait two or more years for their next birth, or are undecided about the timing of the next birth, or are undecided whether to have another child.

The existing literature on demand for contraception and unmet need (Rafalimanana & Westoff, 2000; Magadi, 2003) indicates that the demand for family planning to postpone births is globally consistent with demographic and health factors, while socioeconomic and cultural factors vary across countries. The desire to postpone births is negatively correlated with the death of the previous child and the age of the mother; but positively associated with the number of living children, the birth order of the last child as well the women's levels of family planning knowledge and approval of contraceptives. By contrast, the association between demand and socio-economic factors displays a variety of effects. The exposure to family planning messages from the media, the extent of discussion on family planning by couples, the level of education of the mother and place of residence are positively associated with preferences in some countries but not in others. For Rwanda, Ndaruhuye, Broekhuis and Hooimeijer (2009) have shown that the relationship between the demand for family planning and socio-economic factors is very limited. Poor, less educated women are as desiring of family planning as the rich and better educated.

Unmet need is also consistently related to demographic factors but not to socioeconomic factors, which showed different outcomes across countries including positive, negative or no relationship (Mills, Bos & Suzuki, 2010; Magadi, 2003; Bongaarts & Bruce, 1995). Unmet need for spacing decreases with woman's age and increasing length of the preceding birth interval, but increases with parity and birth order. The variety in the relationship between socioeconomic factors and unmet need seems to be due to differences in the fertility transition. The relationship is positive in pre-transition countries and negative for those in the mid-transitional phase. During the transition, unmet need increases with modernization and appears first in the higher stratum of the population that desires fewer children without using contraceptives accordingly. In the lower strata, fertility preferences are still high and match fertility behavior. In that case, there is no unmet need. In a later stage, the convergence of desired and actual fertility by using contraceptives among the higher stratum reduces the

unmet need, while unmet need widens among the lower strata that are just starting to want smaller families without actually controlling births yet. As Rwanda is in the mid-transitional phase, a strong effect of socio-economic factors is to be expected.

To understand the drivers of demand and barriers to contraception that sustain unmet need, it might be helpful to look at the three preconditions for the adoption of contraception as developed by Coale (1973) and Lesthaeghe and Vanderhoeft (2001): readiness, willingness and ability. Readiness refers to the need to postpone births or cease childbearing altogether, usually as a result of socio-economic development (Cleland, Ndugwa & Zulu 2011). However, lack of resources and prospects may also lead to readiness. Ndaruhuye et al. (2009) found evidence for so-called poverty-Malthusianism in Rwanda. Even among the poor the readiness to limit the number of offspring turned out to be prevalent, related to the land pressure in the country. Willingness is the attitude towards contraceptive use or certain contraceptive methods, grounded in traditional beliefs, culture, ethical considerations, codes of conduct, religious prescriptions, and legitimacy. Bawah, Akweongo, Simmons and Phillips (1999) have indicated that in Africa the use of modern contraception is limited despite the awareness of the need for it, indicating a lack of willingness. Ability refers to the knowledge of contraceptive methods, the supply of services and access to these services. Readiness, willingness and ability are obvious preconditions to use contraception.

In this paper, readiness is measured by the reported desire to postpone the next birth. However, not all women who are ready to postpone are also willing to adopt contraception as a means to achieve their reproductive preference. Different barriers, particularly socio-cultural, may make them to be reluctant about the methods to be used. Westoff (2013) and Ndaruhuye et al. (2009) have found that having a Protestant religion was associated with such resistance. For these women, ability in terms of access or availability of contraceptives does not overcome these barriers. Thus they have unmet need despite their readiness. Furthermore, some women may be unable to get family planning means for various reasons, including geographic distance, limited knowledge, social opposition, etc. These women will be in the unmet need category, just as the women without willingness.

Based on this literature and the specific situation in Rwanda we have formulated the following hypotheses. The desire for longer birth intervals depends primarily upon the bio-demographic factors that determine actual intervals: the duration of postpartum amenorrhea, level of fecundity, and the duration of the previous birth interval (Wolfers, 1968). We therefore expect negative effects on demand for longer amenorrhea, longer previous birth interval and higher age of the mother. Because women are aware of their reduced fecundity we also expect that these factors will be positively related to not using contraception even if there is a desire to postpone the next birth. Education is a resource that provides knowledge and therefore triggers demand and it also enables meeting this demand. Better education is therefore expected to be positively associated with demand for family planning and negatively associated with unmet need. Previous research has found that other socio-economic variables, like wealth and occupation are not related to demand in Rwanda, but are expected to be negatively related to unmet need (Ndaruhuye et al., 2009). We expect that women with higher income, or residing in urban areas compared with rural dwellers, will be more able to achieve their preferred birth intervals than their counterparts. Child mortality and child morbidity will have opposing effects on the desire to postpone the next birth. Mortality leads to rapid replacement, in particular of the index child. In contrast, reduced health of the current children will lead to the desire to wait longer in having a next child. A preference for larger families will have a negative effect on postponement.

Data and Methodology

Data

The study uses pooled data from the 2005 and 2010 RDHS. Since this study focuses on birth spacing, the sample has been restricted to married/partnered women who have at least one child and want another. The reason to not include women without a partner and women who have no children yet is that these women are bound to have specific reasons and constraints in avoiding or postponing the (next/first) pregnancy. Intercourse before marriage is still a taboo in Rwanda and the statutory age at marriage of 21 years is high. Few women without children in our dataset were (willing to) express a desire to use contraception. The combined sample has 6,460 respondents (Table 1).

Analysis Model: Selection Bias and Bivariate Probit With Sample Selection

In this paper, we consider the decision to use contraception as a two-step process. The first step is the need to postpone births and the second the adoption of contraceptives to achieve the desired interval. These two steps might not be independent from each other, as the decision to use contraceptives builds on the need to postpone births. A correlation between the two is thus to be expected. Women at risk of unmet need are those who have a demand for spacing. Consequently, the sub-sample of women with demand that can be used for assessing unmet need is not randomly drawn from the total survey population.

To control for this potential selection bias and to get an accurate estimation of the parameters of unmet need, we use the Heckman (1979) sample selection model. As the dependent variables are dichotomous, we applied bivariate probit regression. The model involves two probits in simultaneously estimating two equations: the first estimates the probability of desiring to postpone the next birth (selection or demand equation) and the second estimates the probability that no method is used to avoid pregnancy (outcome or unmet need equation) despite this desire. The equations are presented as follows:

Outcome equation

$$Y = \beta X + \varepsilon \qquad \text{where Y is observed only if } Y' = 1$$

Selection equation

$$Y' = \beta' X' + \eta \qquad \text{where } Y' = 1 \text{ if } (\beta'X' + \eta) > 0, \text{ and } Y' = 0 \text{ if } (\beta'X' + \eta) \le 0$$

Correlation $(\varepsilon, n) = p$

Where:
- Y is the log of the dependent variable and X a set of independent variables of the outcome equation (unmet need);
- Y' is the log of the dependent variable and X' a set of independent variables of selection equation (demand);
- β & β' reflect the impact of independent variables;
- ε & n are the residuals of the equations; and
- p is the coefficient of correlation between the errors of the two equations.

The response variable for the outcome equation is the *unmet need for contraceptive means to space births,* taking the code 1 for women with unmet need and the code 0 for women who have met their need. In the selection equation, the dependent variable is the demand/desire to postpone the next birth, coded 1 if a woman reports this desire and 0 if not. A woman is considered to be in demand for spacing when, using contraception or not, she wants to wait two years or more before having the next birth.

There are two reasons not to use a retrospective approach in defining unmet need for spacing, which limits the analysis to women who have mistimed the previous birth as is done in other research. First, one of the objectives of this study is to identify groups of women who want to space births but still are not willing or able to use contraceptive means to achieve their reproductive plan despite the increased access and availability of family planning services after 2005. Secondly, as was mentioned recently again by Bongaarts (2014) family planning programs could paradoxically widen the gap between wanted and achieved fertility resulting from changes in reproductive attitudes which could cause a rise in demand between 2005 and 2010. A study of unmet need has to include both the change in demand (attitude) and the change in use of contraceptives (behavior). These changes after 2006 are best measured by the desire to postpone the next pregnancy and the use of contraceptives in 2005 and 2010 (Table 2). A retrospective approach would not capture the effects of the family planning policy on the demand.

Independent Variables in the Demand and Outcome Equation in 2005 And 2010

The independent variables are a set of factors covering various aspects associated with birth intervals and/or contraceptive use (Table 1). All variables are derived from the questionnaires of the RDHS 2005 and 2010. Some variables of potential interest, like the attitudes of the partner or the degree of independent decision making by the women, had to be dropped because they were not (consistently) measured in each dataset in Rwanda. Table 1 shows the variables and the categories that we used but also the shifts in the distribution over time for both samples.

Table 1: Percentage distribution of respondents by selected variables, in 2005 and 2010

Demand sample				Unmet need sample			
	2005	**2010**	**Both**		**2005**	**2010**	**Both**
All (N)	3221	3239	6460	All (N)	1694	2273	3967
All (%)	100.0	100.0	100.0	All (%)	100.0	100.0	100.0
Woman's age				**Woman's age**			
15-24	23.1	23.2	23.2	15-24	23.7	24.2	24.0
25-34	55.6	63.6	59.6	25-34	59.3	65.1	62.6
35+	21.2	13.2	17.2	35+	17.0	10.7	13.4
Woman's education				**Woman's education**			
No education	25.6	15.0	20.3	No education	22.1	13.2	17.0
Primary	65.3	74.0	69.6	Primary	66.8	75.4	71.7
Secondary	8.5	8.9	8.7	Secondary	10.2	9.4	9.7
Higher	0.7	2.1	1.4	Higher	0.9	2.0	1.6
Time since last birth (months)				**Place of residence**			
0-11	38.4	30.1	34.2	Urban	19.7	15.4	17.2
12-23	32.5	25.2	28.9	Rural	80.3	84.6	82.8
24-35	18.0	20.2	19.1	**Partner's occupation**			
36-500	11.1	24.5	17.8	Agriculture	72.9	66.7	69.4

Demand sample				Unmet need sample			
	2005	2010	Both		2005	2010	Both
Amenorrhea duration (months)				Man. Skl/Unsk	16.4	19.5	18.2
0-5	13.3	27.1	20.2	Services	10.7	13.8	12.5
6-17	21.0	25.6	23.3	**Household wealth index**			
18-50	9.6	8.6	9.1	Poorest	18.5	19.4	19.0
Still amen <6	19.5	12.8	16.2	Poorer	18.3	20.3	19.5
Still amen >6	36.6	25.9	31.2	Middle	19.7	20.6	20.2
Previous birth interval (months)				Richer	22.3	19.2	20.5
9-23	19.4	16.5	18.0	Richest	21.2	20.5	20.8
24-35	36.5	28.8	32.7	**Religion**			
36-213	27.0	25.4	26.2	Catholic	40.4	40.5	40.4
First birth	17.1	29.3	23.2	Protestant	40.5	42.0	41.3
Mortality experience				Adventist	14.9	14.7	14.8
No death	61.3	78.0	69.7	Muslim	2.2	1.5	1.8
Last birth+	4.6	2.1	3.3	Others	2.0	1.4	1.6
One death	20.7	13.8	17.2	**Amenorrhea duration** (months)			
Two+	13.5	6.1	9.8	0-5	19.0	32.3	26.6
Child's underweight index				6-17	29.6	30.8	30.3
<1000	19.5	14.6	17.0	18-50	10.5	9.2	9.8
1001-4000	11.9	16.0	14.0	Still amen <6	14.9	7.7	10.8
4001-9980	11.7	14.6	13.2	Still amen >6	26.0	20.0	22.6
Not weighed	56.9	54.8	55.8	**Previous interval** (months)			
Child is ill				9-23	24.1	18.4	20.8
No	45.4	54.8	50.1	24-35	40.7	29.9	34.5
Yes	54.6	45.2	49.9	36-213	20.5	22.9	21.9
Woman's ideal # of children				First birth	14.7	28.9	22.8
0-3	16.5	52.8	34.7	**Heard family planning message in media**			
4	41.7	30.7	36.2	No	48.5	31.6	38.9
5-6	31.8	12.6	22.2	Yes	51.5	68.4	61.2
7+	10.1	4.0	7.0	**Family planning worker visits**			
				No	93.5	68.9	79.4
				Yes	6.5	31.1	20.6

In the demand sample, most of the respondents (60%) are aged 25-34 years and the majority (70%) has only a primary educational level. This proportion has slightly increased from 65% in 2005 to 74% in 2010. At the time of the interviews, more than a third (37%) of the population already had a healthy interval of two years and more since their last birth. Overtime, that category has increased from 29% to 45%. In addition, nearly half of the respondents (47.4%) were still in the amenorrhea period, a proportion which has significantly declined from 56% in 2005 to 39% in 2010, a result of the fact that the proportion of women who gave birth recently has declined.

Table 1 shows that a large majority of the respondents (70%) had not yet lost any child and among the 30% who had lost one or more of their children, 20% had lost one child, and only 3% had lost the last child. Half of the index children were ill during the three weeks preceding the interview and the other half were not. All of these health indicators have improved in 2010. Similar to mortality, fertility preference has also changed overtime. The proportion of women desiring small families (<=3 children) has increased dramatically from 17% in 2005 to 53% in 2010, while those preferring large families (7 children and more) dropped from 10 to 4% respectively.

The population in the subsample of unmet need were in the majority (63%) aged 25-34 years, and 72% had a primary educational level. Only 11% reached secondary school or more. Most of them (69%) were married to cultivator men and more than 80% were Catholic (40.4%) or Protestant (41.3%). A third of the sampled women were still in the amenorrhea period at the time of interview. This proportion was 41% in 2005 and 28% in 2010. Nearly a quarter of the women in need of postponing were at first birth. Short intervals (< 2 years) and longer intervals (> 3 years) were experienced by 20% of the women. More women (68%) had heard about family planning from the media in 2010 than in 2005 (52%). No less than 31% of the women who want to postpone the next birth were visited by a family planning worker in the year before the interview in 2010, as opposed to only 6.5% in 2005. Both the sensitizing campaign to limit family size to three children and the improvement of family planning programs show their mark in the figures on ideal family size and the visits by family planning workers.

Results

Changes over Time in Demand and Unmet Need

The effects of the above policies are reflected in the shift in both the demand for family planning and the levels of unmet need. Table 2 shows the changes in both for each independent variable.

Table 2: Percentage of women with demand and unmet need for birth-spacing in 2005 and 2010 by selected variables

Demand	2005	2010	Unmet need	2005	2010
All (N)	3221	3239	All (N)	1694	2273
All (%)	52.6	70.2	All (%)	76.2	31.8
Amenorrhea duration (months)			**Amenorrhea duration** (months)		
0-5	75,1	83.8	0-5	63,4	20.4
6-17	74,0	84.5	6-17	69,1	26.1
18-39	57,6	75.0	18-39	75,3	37.1
Still amen < 6	40.1	42.1	Still amen < 6	94.8	72.6
Still amen > 6	37.4	54.1	Still amen > 6	83.4	40.7
Previous interval (months)			**Previous interval** (months)		
9-23	65,2	78.3	9-23	70,8	29.2
24-35	58,6	72.7	24-35	81,3	38.7
36 +	40,1	63.3	36 +	75,6	36.2
First birth	45,2	69.1	First birth	71,9	22.9
Woman's age			**Woman's age**		
15-24	53,8	73.1	15-24	77,3	27.8
25-34	56,1	71.8	25-34	75,1	31.6
35 +	42,1	57.0	35 +	78,5	42.2
Woman's education			**Woman's education**		
No education	45,4	61.6	No education	87,2	40.7
Primary	53,8	71.5	Primary	76,7	31.9
Secondary	63.0	74.1	Secondary	55.2	22.4
Higher	72.7	68.7	Higher	12.5	13.0

Demand	2005	2010		Unmet need	2005	2010
Time since last birth (months)				**Residence type**		
0-11	47,1	57.7		Urban	62.2	28.9
12-23	59,6	79.9		Rural	79.6	32.4
24-35	60,2	78.6		**Partner's occupation**		
36-263	38,8	68.6		Agriculture	80.9	33.9
Infant mortality experience				Man skl/unsk	73.7	27.4
No loss	55,7	72.6		Services	48.3	28.0
Lost last child +	35,4	36.8		**Household wealth index**		
One loss not last	51,9	68.1		Poorest	86,3	41.3
Two or + loss	45,4	55.6		Poorer	81,6	37.9
Child's underweight index				Middle	76,9	28.9
0-1000	59.2	78.0		Richer	78,2	27.5
1001-4000	50.0	73.9		Richest	59,9	23.9
4001-9980	50.5	65.2		**Woman's religion**		
Not weighted	51,3	68.3		Catholic	72,8	28.3
Child is ill				Protestant	82.5	35.5
Not ill	49.6	68.4		Adventist	71.5	29.3
Ill	55.1	72.3		Muslim	68.4	42.4
Ideal # of children				Others	60.6	38.7
0-3	56.2	71.7		**Heard about family planning in media**		
4	53.2	69.1		Yes	69.0	28.2
5-6	53.2	69.0		No	83.8	39.6
7+	42.1	62.5		**Family planning worker visits**		
				Yes	79.1	34.4
				No	76.0	30.7

The share of women who want to postpone the next birth has increased from 52.6 to 70.2%. Looking at the various categories it looks as if this rise has occurred across the board, yet there are a few notable exceptions. Women who are in amenorrhea for less than 6 months show the same desire to postpone the next birth in both 2005 and 2010. And women who lost their index child are keen on getting pregnant again (only 37% want to postpone in 2010, the same as in 2005). Another striking figure is that even the ones who are at a healthy interval of more than two years also have a higher percentage who want to postpone in 2010.

Even more spectacular is the decrease in unmet need, which dropped from 76.2% in 2005 to 31.8% in 2010. Education, occupation and wealth seem to have lost a large part of their effects on unmet need. Socio-economic inequality is still reflected in the level of unmet need in 2010 but far less than in 2005. This raises the question of which factors have changed significantly over time, which can only be answered using a multivariate model.

The Heckman Model

The family planning sensitizing and advocacy campaigns were aimed at limiting families to three children, but as people have been made more aware of contraceptive use, the demand for spacing has also increased (Table 2). We included year of the interview as a main effect in the demand equation and tested all the interaction effects to check which specific factors changed over time in their effect on demand. The mainstreaming of reproductive health is bound to have effects on the unmet need for spacing in particular for those that experienced barriers to access of contraceptives before. We included year of the interview in the unmet need equation and tested explicitly the interaction effects with the socioeconomic variables (Table 3).

For demand we do find a positive main effect for the year of the interview (0.429) which indicates an overall increase in demand for each category of the independent variables without interaction effects taken into account. Interaction effects are only significant for mortality experience and ideal family size. For our reference category, the highly positive constant in the model (1.229) shows that a large majority of women want to postpone the next birth. For those who had their last child between 12 and 24 months ago the effect is the same. But even women who are at healthy intervals often want to postpone the next birth. Women whose last birth occurred two to three years ago have a coefficient of -0.331.The coefficient drops to -0.672 if the period exceeds three years. This nevertheless means that also among these a majority do not want another child within two years.

At the time of the interview, a substantial proportion of the respondents (37%) were already at an interval of two years or more since the last birth (Table 1). As expected this has a negative effect (-0.331) on the demand for further spacing which is obviously even stronger (-0.672) after an interval of three years or more. A negative relationship is also found with the previous birth interval. Women who had an interval longer than three years before their last birth have a coefficient of -0.491. In addition, nearly half of women in the sample (47.4%) are still in postpartum amenorrhea (Table 1), a period in which women believe themselves to be at a lower risk of getting pregnant. This shows up in the probit model in the negative coefficients (-1.385 and -1.238) of the categories of being in amenorrhea for less or more than six months. The difference between the two is significant. Women in the first half year after giving birth are less likely to consider postponing the next birth.

The demand for contraception decreases with the desired family size. Women who want more than six children are less inclined (coefficient is -0.370) to postpone compared with those wanting fewer (less than 4). Poor health of children measured as the most recent born being ill or underweight raises the desire to postpone the next birth by 20%. Infant and child mortality have the expected negative effect on postponement. Women who lost their latest child are less likely (a coefficient of -1.053) to postpone the next pregnancy. This rapid replacement effect occurs less when it concerns the loss of one or more non-index children. Highly educated women are more likely (coefficient is +0.307) than those with no education to desire to postpone the next birth.

Losing the index child has a stronger effect in 2010 than in 2005 (the coefficient moves from -1.053 to -1.528) and losing two or more children also decreases the desire to wait for the next birth (only significant at 0.10). Infant and child mortality have been reduced in Rwanda between 2005 and 2010, but those who experienced mortality are now more eager to replace the child(ren) lost. The only other shift over time is the increased desire to space among the women who want to have more than six children (the coefficient moves from -0.370 to –0.016 (-0.370+0.354), meaning that the effect of wanting many children on the spacing of births has disappeared.

Table 3: Heckman probit model coefficients of the demand/unmet need to space births

Demand Equation	β	SE	Unmet need equation	β	SE
N Observations = 6460			N Observations = 3967, Censored = 2493		
Variable *(ref category)*			Variable *(ref category)*		
Constant	1.229***	0.113	Constant	0.956***	0.137
Year (2010 vs 2005)	0.429***	0.072	Year (2010 vs 2005)	-1.477***	0.122
Amenorrhea duration (0-5 months)			Amenorrhea duration (0-5 months)		
6-17	-0.030	0.060	6-17	0.108*	0.057
18-50	-0.295***	0.075	18-50	0.404***	0.080
still amen < 6	-1.385***	0.073	still amen < 6	1.508***	0.088
Still amen >6	-1.238***	0.057	still amen > 6	0.797***	0.072
Previous interval (<24 months)			Previous interval (<24 months)		
24-35	-0.109**	0.053	24-35	0.164***	0.061
36-248	-0.491***	0.055	36-248	0.227***	0.067
First birth	-0.835***	0.063	First birth	0.208***	0.072
Time since last birth (0-11 months)			Residence (rural vs urban)	-0.014	0.068
12-23	-0.013	0.053	Partner occupation (agriculture)		
24-35	-0.331***	0.063	manual skilled	-0.029	0.094
36-500	-0.672***	0.062	Services	-0.481***	0.109
Woman's age (15-24)			Woman's age (15-24)		
25-34	-0.018	0.048	25-34	0.055	0.056
35+	-0.108*	0.065	35+	0.237***	0.082
Education (no education)			Education (no education)		
Primary	0.137***	0.044	Primary	-0.315***	0.092
Secondary	0.307***	0.073	Secondary	-0.576***	0.133
Higher	0.307**	0.160	Higher	-1.473***	0.386
Mortality experience (no death)			Wealth index (poorest)		
last birth+	-1.053***	0.119	poor	-0.081	0.066
one death	-0.130**	0.061	Middle	-0.233***	0.067
two deaths+	-0.210***	0.074	Richer	-0.218***	0.068
Child is ill (yes vs no)	0.203***	0.036	Richest	-0.326***	0.083
Child underweight index (1000-4000)			Religion (catholic)		
0-1000	0.176***	0.062	Protestant	0.258***	0.047
4000-9980	-0.002	0.066	Adventist	0.056	0.061
Not weighted	0.104**	0.051	Muslims	0.488***	0.158
Ideal # children (1-3)			Others	0.047	0.158
4	-0.109	0.069	Heard fp mssage (yes/ no)	-0.274***	0.070
5-6	-0.087	0.072	Family planning worker visits	0.056	0.053
7+	-0.370***	0.095	(yes vs no)		
Interaction effects			**Interaction effects**		
Mortality experience in 2010 (no death in 2005)			Heard family planning message in media in 2010 (2005)	0.091*	0.089
last birth+	-0.475**	0.190	Education in 2010 (no educ 2005)		
one death	-0.030	0.092	Primary	0.212*	0.118
two deaths+	-0.214*	0.120	Secondary	0.289	0.177
Ideal # children in 2010 (1-3 in 2005)			Higher	0.996**	0.442
4	-0.026	0.088	Partner occupation in 2010 (agric in 2005)		
5-6	0.005	0.104	Manual skilled	0.018	0.114
7+	0.354**	0.153	Services	0.585***	0.136
rho	-0.627323				
LR test of independents	0.000				

Despite the higher demand in 2010, the levels of unmet need have dropped dramatically as seen in Table 2. The constant in the unmet need model in Table 3 reflects the log odds for our reference category (young, poor, uneducated women whose partner is a cultivator). In 2005

the constant is 0.956. In 2010 this coefficient becomes -0.521 (0.956-1.477). This raises the question of which barriers to the use of contraceptives have been removed. Looking at the combined main effect and interaction effect of the occupation of the partner, we find that this distinction has become irrelevant. Adding the coefficients for the ones that work in the services sector (-0.481+ 0.585=0.104) indicates that the ones in the services sector had the same or even a slightly higher level of unmet need in 2010 compared to those in agriculture. The effects of education show a similar course. The combined main effect of 2005 and the interaction effect of 2010 exhibits smaller educational differences in unmet need in 2010. For those with a primary education the coefficient becomes -0.103 (-0.315 + 0.212), for secondary -0.287 (-0.576+0.289) and for higher educated -0.477 (-1.473+0.996), meaning that people without education have nearly caught up with those with better education, even though the differences between those with a secondary or higher education are still significant.

The other variables did not have significant interaction effects with the year of the survey and the relative differences have remained the same over time, yet at an overall lower level of unmet need. The wealthiest 60% of the population still has lower levels of unmet need (-0.22 to -0.33). The effect of religion has also remained unchanged. Protestants (0.258) and Muslims (0.488) are still lagging behind Catholics when it comes to controlling the spacing of births. Lack of information regarding family planning through media increases the propensity to be in unmet need (coefficient -0.274) while the visits of a family planning worker to individuals do not show any independent effect.

Looking at the other factors, unmet need for delaying a birth is positively correlated with the previous birth interval and the duration of the amenorrhea period. Women whose last birth occurred three years or more after the preceding birth are more likely (0.227) to not use contraception even if they want to postpone the next birth. Primiparous women display a similar pattern to those with longer previous intervals. Experienced women seem to place trust in their previous experience while primipara do not yet know their natural birth-spacing behavior. By believing in the protecting role of an amenorrhea status, women in that category have higher risk of unmet need, especially in the first six months during the so-called lactation amenorrhea (coefficient of 1.508). For those with more than six months post-birth, the risk of unmet need declines substantially but remains high (coefficient of 0.797) indicating that some women have started using contraceptive methods because they don't yet totally trust the protective effect of the late amenorrhea.

The results from our model confirm the existence of selection bias. The coefficient rho (-.627) of the test for independence of equations is statistically significant at p<0.01. The negative sign of the coefficient indicates that error terms in the demand and unmet equations are negatively correlated. The selected cases for the unmet need equation tend to be those with lower probability of being with unmet need compared to those which have not been selected. This means that women who did not express a manifest demand would have had higher level of unmet need if they were to space the next birth.

Conclusion and Discussion

The preference for longer birth intervals has always been a concern of Rwandan women and they still prefer to space their births. Despite that propensity, many women do not use contraceptives to achieve their reproductive plan. The objective of this research was to identify factors driving the demand for birth spacing and those sustaining unmet need. We

also assessed the recent progress in meeting this demand, and identified the factors that are still pertinent to unmet need in 2010.

Our results confirm this desire for very long intervals between births. In 2005 two-thirds of the women who had their last child more than three years ago, still wanted to wait another two years before having the next. In 2010 this share increased to three out of four. More generally, the share of women who want to wait for more than two years before having another child increased by more than half. The structure of this demand hardly changed over time. Bio-demographic variables like age, the time since last birth, the duration of the period of amenorrhea, and the previous intervals between births showed the same effects in 2010 as they did in 2005. This is in line with research on other countries which showed a consistent negative relation between reduced fecundity and the demand for contraceptives (Magadi, 2003). As infant mortality decreases, replacement fertility increases. In particular the loss of the index child strengthened the desire to become pregnant again in 2010.

More impressive than the raise in demand, is the decline in unmet need. The situation in 2005 is consistent with the literature on fertility transition theory. In the second phase of the transition, the demand for contraceptives is common among all strata of the population, but only the higher socio-economic strata are able to actually acquire the means to control their reproduction (Bongaarts, 1997). We found strong effects of education, occupation and wealth. However we also found that between 2005 and 2010 many of these effects diminished substantially, which is surprising seen the short period of time. The effect of occupation disappeared completely and the effect of education diminished to a magnitude of a 10% difference between the uneducated and the higher educated. Controlling for these variables the effects of wealth remained. The poorest 40% of the population still showed substantially higher levels of unmet need in 2010, which could point at other costs involved in using contraceptives (since contraceptives are supplied free of charge.)

This finding is in line with other studies (Westoff, 2013; Budervoet, 2014) confirming that Rwanda is undergoing a fertility transition which is unlikely to stall. Not only have fertility preferences for larger families dropped, but having closely spaced births has become unpopular. The desire for longer intervals may have been one of the motivations for the increase in contraceptive use recorded in 2010 and the resulting fertility decline. The existence of a substantial demand to postpone the next birth among women who already have achieved healthy intervals is in line with what Timaeus and Moultrie (2008) have called "perpetual postponers", a phenomenon which often leads to family limitation. As Westoff and Koffman (2010) argue, many women who are limiting child births have started by being spacers. The potential effect of birth postponement on fertility is to accelerate the fertility decline in a way that birth spacing to healthy intervals does not.

Although reproductive attitudes and behavior are changing quickly in Rwanda (Habimana & Jensen, 2009), cultural factors like religion still matter, as was also found in other studies (Westoff, 2013; Muhoza, Broekhuis & Hooimeijer, 2014). Religion represents a non-negligible factor that makes part of the population reluctant to use contraception. In particular Muslims and Protestants continue to show a lower propensity to use contraception than other groups. The group of Protestants is not homogenous; it comprises various denominations that may have different attitudes. Pentecostals are well-known to be more adverse to family planning (Twizeyimana, 2005); but among Anglicans, Presbyterians and others there is more acceptance. Note that the proportion of Protestants is growing in Rwanda: they represented 37% of the whole population in 2012 while they constituted only 19% in 1992 and 15% in 1978 (NISR, 2014).

The impressive decline in unmet need may mainly be attributed to the government commitment to strengthen family planning services through sensitizing and advocacy campaigns, and improvements in service provision. It is important to maintain these efforts in order to pursue and accelerate the on-going fertility transition. It has been demonstrated elsewhere (DaVanzo & Adamson, 1998; Bulatao, 1998) that short term programs produce short results, and that a reduction of efforts slows down the on-going changes.

The current policy in Rwanda of mainstreaming reproductive health services, of mandatory community health insurance schemes, and of introducing community based health workers is geared to the socio-economic barriers that we found still existed in 2010. With an almost universal acceptance among the women in Rwanda that one needs to space births, bringing services closer to the poor and less educated in the community is bound to be effective in further reducing the barriers to modern contraceptives. Continued advocacy might be called for to also increase the willingness among the population that does see the need to space births but refrains from using methods for religious reasons.

Limitations

Using the Heckman model allowed us to more precisely identify the factors that determine the level of unmet need and to include the latent demand for contraceptive use. The fact that we found significant selection effects shows that this is not superfluous. Yet dropping the selection model has only limited effects on the coefficients in the outcome model. In a context where the need for family planning is almost universal, latent demand becomes less important and selection effects may be ignored without too much loss of explanatory power.

Acknowledgement

References

Bawah, A. A., Akweongo P., Simmons R. & Phillips J. F. (1999). Women's fears and men's anxieties: the impact of family planning on gender relations in northern Ghana. *Studies in Family Planning*, 30 (1): 54-66.

Bongaarts, J. (1997). Trends in unwanted childbearing in the developing world. *Studies in Family Planning*, 28 (4), 267-277.

Bongaarts, J. (2014). The impact of family planning programs on unmet need and demand for contraception. *Studies in Family Planning,* 45 (2), 247–262.

Bongaarts, J. & Bruce, J. (1995). The causes of unmet need for contraception and the social content of services. *Studies in Family Planning,* 26 (2), 57-75.

Bulatao, R. A. (1998). *The value of family planning programs in developing countries*. Santa Monica CA: RAND Corporation. Retrieved from
http://www.rand.org/pubs/monograph_reports/MR978.html

Budervoet, T. (2014). What explains Rwanda's drop in fertility between 2005 and 2010? *Policy Research Working Paper 6741.*The World Bank, Africa Region, Poverty Reduction and Economic Management Unit.

Cleland, G. J., Ndugwa, P. R. & Zulu, M. E. (2011). Family planning in sub-Saharan Africa: progress or stagnation? *Bulletin of the World Health Organization*, 89 (2): 137–143.

Coale, A. J. (1973). The demographic transition reconsidered. In International Union for the Scientific Study of Population (IUSSP) (Eds.), *Proceedings of the international population conference 1973*, 1: 53-73. Liège, Editions Ordina.

Conde-Agudelo, A. & Belizan, J. M. (2000). Maternal morbidity and mortality associated with inter-pregnancy interval: Cross sectional study. *British Medical Journal*, 321, 1255-1259. Retrieved from http://www.bmj.com/cgi/content/full/321/7271/1255

Crystal, P. (2008). *Integrating IEC Messages on vaccination, birth spacing, and HIV in Rwanda.* Arlington, Va., USA: Basic Support for Institutionalizing Child Survival (BASICS) for the United States, Agency for International Development (USAID).

Da Vanzo, J. & Adamson, D. M. (1998). *Family planning in developing countries: An unfinished success story*. Santa Monica, CA: RAND Corporation. Retrieved from http://www.rand.org/pubs/issue_papers/IP176

Gipson, J. D., Koening, M. A. & Hindin, M. J. (2008). The effects of unintended pregnancy on infant, child, and parental health: A review of the literature. *Studies in Family Planning,* 39 (1), 18–38.

Habimana, D. & Jensen, J. (2009, 11 November). *Country on the move: Rwanda's family planning efforts begin to pay off.* Retrieved from http://unfamily planninga.org/public/news/pid/4262

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica,* 47, 153-161.

Ilinigumugabo, A. (1989). *L'espacement des naissances au Rwanda: niveaux, causes et consequences. [Birth spacing in Rwanda: levels, causes and consequences.]* PhD Thesis. Louvain-la-Neuve, Belgium: CIACO.

Lesthaeghe, R. & Vanderhoeft, C. (2001). Ready, willing, and able: a conceptualization of transitions to new behavioral forms. In: Casterline J. B., (Ed.). *Diffusion processes and fertility transition: selected perspectives.* Washington: National Academy Press.

Magadi, A.M. (2003). Unplanned childbearing in Kenya: the socio-demographic correlates and the extent of repeatability among women. *Social Science & Medicine*, 56, 167–178.

May, J. F. (1995). Policies on population, land use, and environment in Rwanda. *Population and Environment: A Journal of Interdisciplinary Studies,* 16 (4), 321-334.

Mills, S., Bos, E. & Suzuki, E. (2010). *Unmet need for contraception.* Washington, DC: World Bank.

Muhoza, N. D., Broekhuis, A. & Hooimeijer, P. (2014). Variations in desired family size and excess fertility in East Africa. *International Journal of Population Research*, Vol 2014, 11 pages. doi: http://dx.doi.org/10.1155/2014/486079

National Institute of Statistics of Rwanda (NISR). (2014). *Fourth population and housing census, Rwanda, 2012. Thematic report: Socio-cultural characteristics of the population.* Kigali: NISR.

National Institute of Statistics of Rwanda (NISR) & ORC Macro. (2006). *Rwanda demographic and health survey 2005.* Kigali: NISR; Calverton, MD, U.S.A: ORC Macro.

National Institute of Statistics of Rwanda, Ministry of Health & ICF International. (2012). *Rwanda demographic and health survey 2010*. Kigali: NISR, MoH, Calverton, MD, USA: ICF International.

Ndaruhuye, M. D., Broekhuis, A. & Hooimeijer, P. (2009). Demand and unmet need for means of family limitation in Rwanda. *International Perspectives on Sexual and Reproductive Health,* 35 (3), 122–130.

Office National de la Population [ONAPO]. (1994). *Enquête Démographique et de santé 1992. [Demographic and Health Survey 1992].* Kigali: ONAPO, Calverton, MD, USA: Macro International.

Ojakaa, D. (2008). Trends and determinants of unmet need for family planning in Kenya, *Working Papers 56.* Calverton, Maryland, USA: Macro International Inc.

Rafalimanana, H. & Westoff, C. F. (2000). Potential effects on fertility and child health and survival of birth-spacing preferences in sub-Saharan Africa. *Studies in Family Planning*, 31 (2), 99-110.

Rutstein, S. (2003). *Effect of birth intervals on mortality and health: Multivariate cross country analyses.* Presentation to USAID-sponsored Conference on Optimal Birthspacing for Central America, held in Antigua, Guatemala.

Singh, S., Sedgh, G. & Hussain, R. (2010). Unintended pregnancy: Worldwide levels, trends, and outcomes. *Studies in Family Planning,* 41 (4), 241–250.

Timæus, M. I. & Moultrie, T. (2008). On postponement and birth intervals. *Population and Development Review*, 34 (3), 483-510.

Twizeyimana, A. B. (2005). *Rwanda, une nouvelle naissance n'est plus une fête [Rwanda, a new birth is no longer a celebration]*. Retrieved from
http://www.syfia.info/index.php5?view=articles&action=voir&idArticle=4259

USAID-Rwanda, Twubakane. (2008). *Decentralization and health program Rwanda: Quarterly performance monitoring report 15, July-September 2008.* Kigali: Ministry of Health, Ministry of Local Administration, USAID-Rwanda

Westoff, C.F. (2001). *Unmet need at the end of the century.* DHS Comparative Reports No. 1, Calverton, Maryland: ORC Macro.

Westoff, C. F. (2013). The recent fertility transition in Rwanda. *Population and Development Review,* 38 (Supplement), 169–178

Westoff, F. C. & Koffman, D. (2010). *Birth spacing and limiting connections*. DHS Analytical studies no 21. Calverton, Maryland, USA: ICF Macro

Wolfers, D. (1968). Determinants of birth intervals and their means. *Population Studies, 22,* 253-262.