Estimation of contraceptive prevalence and unmet need for family planning in Africa and worldwide, 1970-2015

Leontine Alkema, Ann Biddlecom and Vladimira Kantorova*

13 October 2011

Short abstract:

Trends in contraceptive prevalence and unmet need for family planning are important to measure because they indicate the degree to which women and their partners are able to prevent unintended pregnancy. Yet many countries have limited data over time, even given broad survey programmes like DHS and MICS. This paper develops a Bayesian hierarchical model of contraceptive prevalence and unmet need for family planning to generate estimates and short-term projections of these outcomes from 1970 to 2015 for women who are married or in a union and to produce bounds of uncertainty around these estimates. The model is based on four levels of hierarchy—country, sub-region, region and world—to capitalize on the full set of available data points and enable data from neighbouring countries to inform national trends. Country-specific and sub-regional trends in Africa are highlighted as well as differences in the estimated pace of change in these outcomes.

* Leontine Alkema: Department of Statistics and Applied Probability, National University of Singapore, Singapore 117546; Contact: alkema@nus.edu.sg. Ann Biddlecom and Vladimira Kantorova: Fertility and Family Planning Section, United Nations Population Division, New York, NY 10017; Email: biddlecom@un.org and kantorova@un.org. The project described is solely the responsibility of the authors and does not necessarily represent the views of the United Nations. Its contents have not been formally edited and cleared by the United Nations.

Introduction

Trends in contraceptive prevalence and unmet need for family planning are important to measure because they indicate the degree to which women and their partners are able to prevent unintended pregnancy. Change over time in these outcomes within and across countries, regions and worldwide also highlights progress towards achieving universal access to reproductive health, a target related to maternal health that is part of the internationally-agreed Millennium Development Goals. However, analysis of trends in contraceptive prevalence and unmet need is challenging. The number of data points for a country is often quite sparse and many countries, especially developing countries, did not have national-level data on contraceptive prevalence until the late 1980s. Even differences among data sources within a country (e.g., the population sampled, whether probed questions were used) can challenge the interpretation of trends over time in these outcomes. In this paper we develop and apply a model to estimate country-specific contraceptive prevalence and unmet need for family planning that capitalizes on a full set of data points, takes into account biases of particular data sources or sample types, incorporates global, regional and sub-regional trends and produces uncertainty estimates for country-specific trends. We provide estimates and short-term (back-) projections of contraceptive prevalence (any method and modern methods) and unmet need for family planning among women aged 15 to 49 years who are married or in a union from 1970 to 2015 for 193 countries and territories. We focus in particular on country-specific and sub-regional trends in Africa and differences in the estimated pace of change in these outcomes.

Data

The observations on contraceptive prevalence and unmet need for family planning are based mainly on *World Contraceptive Use 2010*, an up-to-date set of national data for 193 countries and areas of the world (United Nations, 2011). Contraceptive prevalence and unmet need for family planning are usually reported for married or in-union women aged 15 to 49. Contraceptive methods are for analytical purposes classified as either modern or traditional. Modern methods of contraception include female and male sterilization, oral hormonal pills, the intra-uterine device (IUD), the male condom, injectables, the implant, vaginal barrier methods, the female condom and emergency contraception. Traditional methods of contraception include rhythm (periodic abstinence), withdrawal, prolonged abstinence, breastfeeding, douching, lactational amenorrhea method (LAM) and folk methods. Contraceptive prevalence is obtained from nationally representative household surveys with questions on current use of contraception. Surveys that commonly include this information are: Demographic and Health Surveys (DHS), Fertility and Family Surveys (FFS), Reproductive Health Surveys (RHS), Multiple Indicator Cluster Surveys (MICS) and other national surveys. The set of data points on unmet need for family planning is much more limited and is based mainly on the DHS.

The data have been categorized to take into account the potential differences in outcomes based on population type, data source, age group and geographical region. For instance, MICS has generally not used probe questions on contraceptive methods while DHS does, possibly resulting in more reports of traditional method use from DHS, as for example seen in the case of Burundi (Figure 1). While the population of interest is all married or in-union women, some of the surveys provide information for all women irrespective of marital status or information for all sexually-active women, among other sub-groups. Similarly, age groups different from the baseline age group of 15-49 years might produce biased estimates of contraceptive use. Some data points also refer only to certain geographical regions or subpopulations.

The number of observations for contraceptive use between 1970 and 2010 is limited for many countries. Figure 2 shows that the majority of the 193 countries (64 per cent) have less than five observations on contraceptive prevalence (any method) over this 40 year time period and nearly one-third of countries have just one or two observations. The distribution of 108 countries with data on unmet need for family planning indicates even sparser data, where 86 per cent of countries with data have less than five observations from 1970 to 2010 and just over half of countries with data (55 per cent) have only one or two observations.

Methods

The objective of this study is to construct estimates and short-term (back-) projections of contraceptive prevalence and unmet need for family planning among married or in-union women aged 15 to 49 for all countries, from 1970 until 2015. Because the number of observations is limited in many countries, assumptions need to be made about the general trend in contraceptive prevalence over time. The model assumptions are illustrated in Figure 3.

Total contraceptive prevalence is expected to increase over time, and modern prevalence increases as a proportion of total prevalence. The final level of total prevalence (its asymptote) as well as the pace of the uptake of contraceptive methods and its timing varies between countries. Similarly, the final level of the ratio of modern contraceptive prevalence/total contraceptive prevalence (its asymptote) as well as the pace of the uptake of modern methods and its timing will vary between countries. Contraceptive prevalence does not have to increase smoothly over time. More likely, it will show some fluctuations around the main trends, as illustrated with the trajectories around total, traditional and modern prevalence (the jagged lines in figure 3). Logistic curves are used to model the overall trends in total contraceptive prevalence and the ratio of modern/total prevalence. Unmet need is modeled as a proportion of the difference between 1 and total contraceptive prevalence. The proportion is modeled as a quadratic function summarizing a general "world" pattern and distortions are added to make the proportion country-specific.

We use a Bayesian hierarchical model (Lindley and Smith 1972; Gelman et al. 2004) to estimate the parameters in each country, such that the estimates are based on the observations in the country of interest, as well as on the sub-regional, regional and global experience. A hierarchical approach to estimating and projecting outcomes for a number of countries is a logical way to exchange information between countries while constructing country-specific estimates and projections. The fewer the number of observations in the country of interest, the more its estimates and projections are driven by the experience of other countries, while in countries with many observations the results will be driven more by its own history.

All model parameters are estimated in a Bayesian framework. Diffuse prior distributions are assigned to the additional model parameters. A Markov Chain Monte Carlo (MCMC) algorithm is used to get samples of the posterior distributions of the parameters (Gelfand and Smith 1990). The MCMC sampling algorithm was implemented using Winbugs software (Lunn et al. 2000). The result is a set of trajectories of contraceptive prevalence and unmet need for family planning for each country. Preliminary estimates of contraceptive prevalence (modern and traditional method use) and unmet need are shown for Burkina Faso and Nigeria in Figure 4 (observed data points are shown as dots or other relevant symbols). The grey areas are 95 per cent confidence intervals, the solid line in the middle in black, purple or green is the country-specific median and the thinner lines around it in the same color are the 80 per cent confidence

intervals. The blue solid lines in the middle of each panel represent the systematic trends (e.g., the logistic curve for traditional method use), where country-specific distortions are not taken into account.

References

Gelfand, A. and A. F. M. Smith (1990). Sampling-based approaches to calculating marginal densities. Journal of the American Statistical Association 85, 398-409.

Gelman, A., J. B. Carlin, H. S. Stern, and D. B. Rubin (2004). Bayesian Data Analysis (2nd ed.). Boca Raton, Fl.: Chapman & Hall/CRC.

Lindley, D. V. and A. F. M. Smith (1972). Bayes estimates for the linear model. Journal of the Royal Statistical Society, Series B 34, 1{41.

Lunn, D., A. Thomas, N. Best, and D. Spiegelhalter (2000). WinBUGS - A Bayesian modeling framework: Concepts, structure and extensibility. Statistics and Computing 10(4), 325{337.

United Nations, Department of Economic and Social Affairs, Population Division (2011). World contraceptive use 2010. (POP/DB/CP/Rev2010).
http://www.un.org/esa/population/publications/wcu2010/Main.html

Figure 1. Example of available data on unmet need for family planning, traditional method use and modern method use by source of data, Burundi
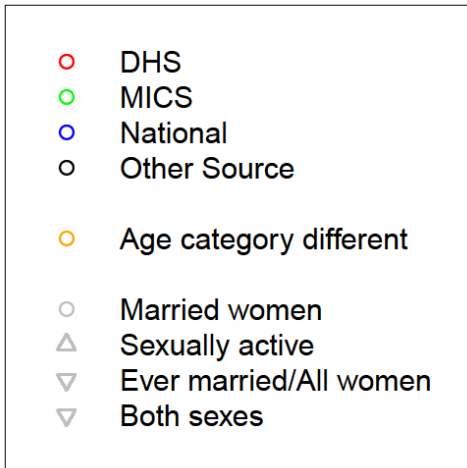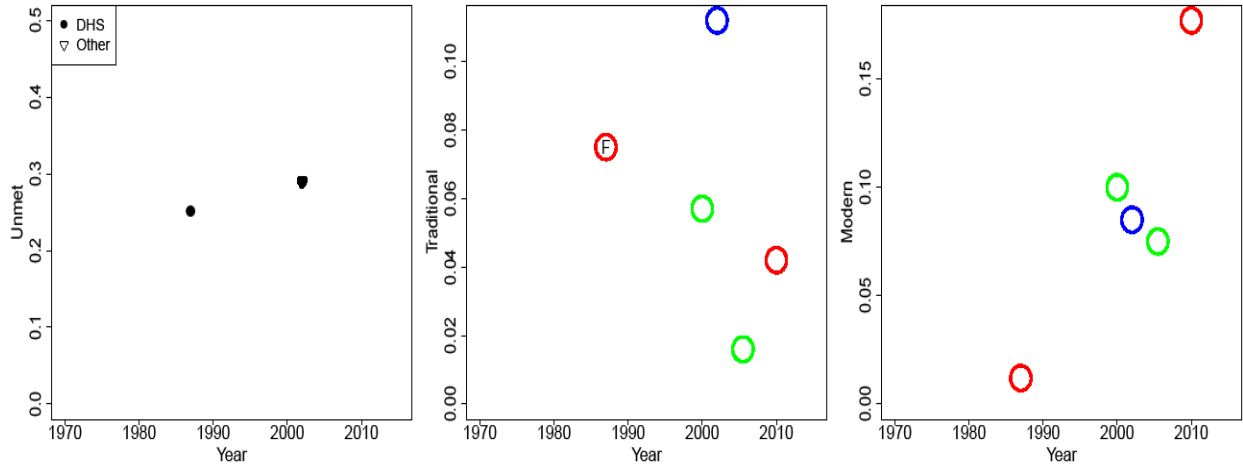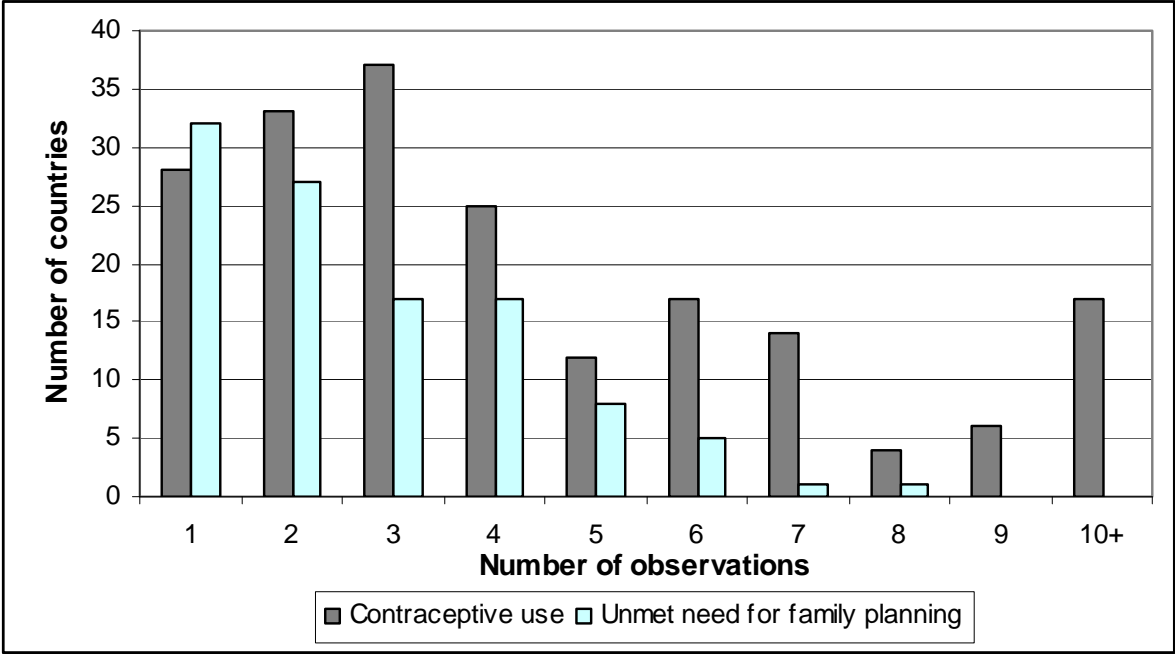
Figure 2. Frequency distribution of countries by number of observations on contraceptive prevalence (any method) and unmet need for family planning

Source: Based on World Contraceptive Use 2010 (United Nations, 2011)

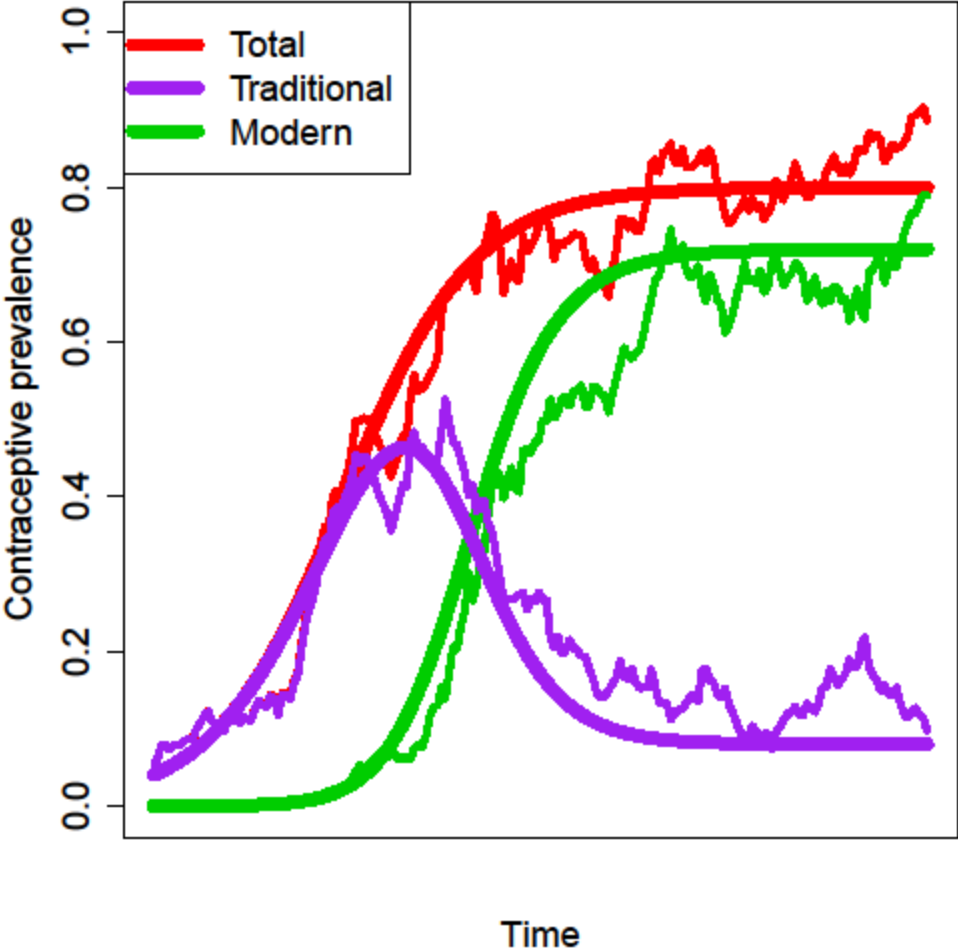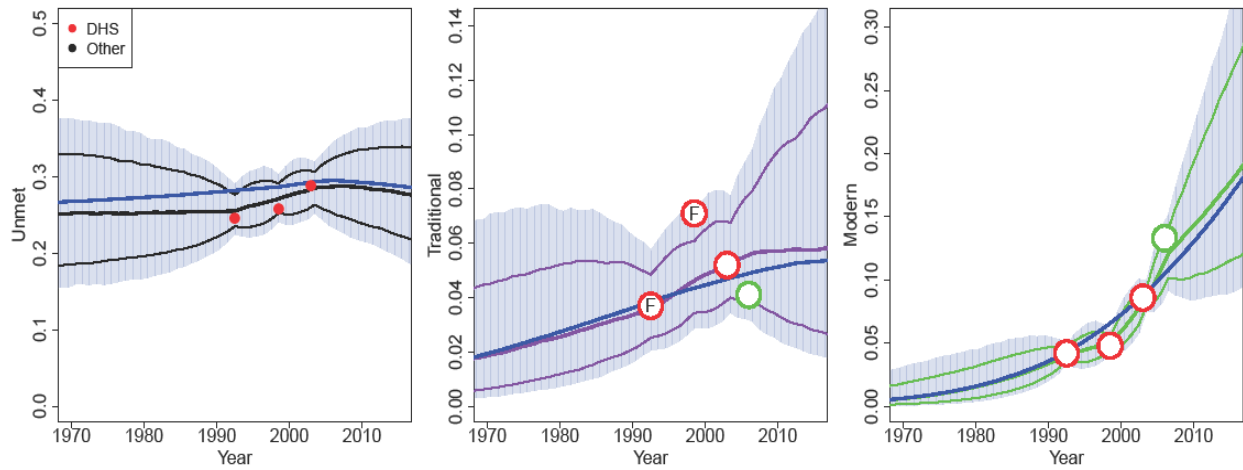**Figure 3. Theoretical model of contraceptive prevalence (total, modern and traditional methods) over time**
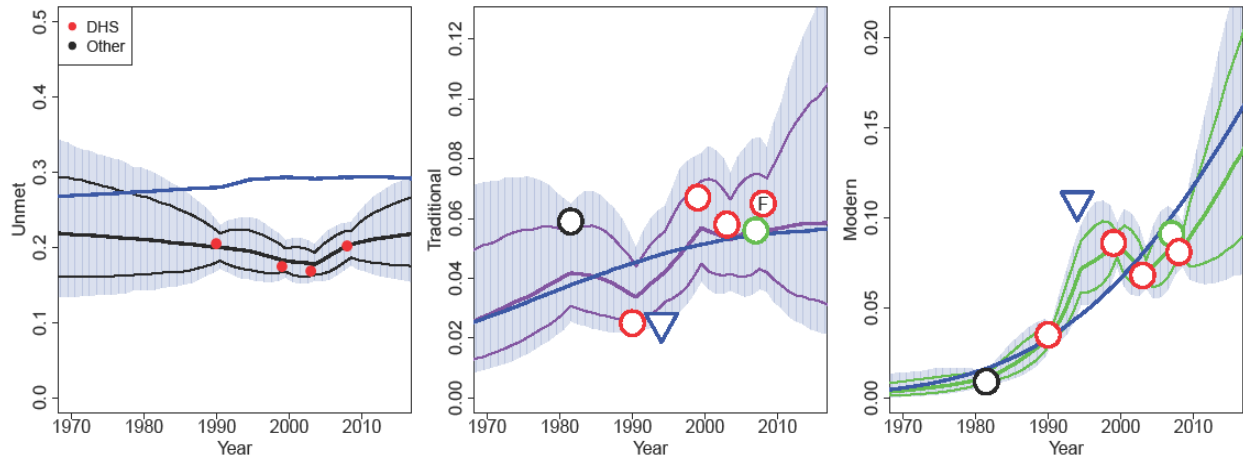
Figure 4. Estimated levels of and confidence intervals around unmet need for family planning, traditional method use and modern method use, 1970-2015

Burkina Faso

Nigeria