

Spatial, Social, and Institutional Determinants of Delivery Place in Rural Mozambique*

Victor Agadjanian

Jing Yao

Sarah Hayford

Center for Population Dynamics
Arizona State University

Abstract

Whereas the coverage of prenatal care in much of rural sub-Saharan Africa has greatly increased, institutional deliveries continue to lag behind as a substantial share of rural women give birth outside clinic settings and without professional obstetric care. This study uses unique longitudinal data from rural southern Mozambique to examine both the probability of having an institutional delivery and the choice of clinic for institutional delivery as a function of individual and household characteristics and of location and characteristics of maternal and child health facilities. Spatial and multivariate regression analyses are employed to determine both additive and interactive effects of the two groups of factors in the context of high HIV prevalence and a massive scale-up of HIV testing, prophylaxis, and treatment services.

* Acknowledgment: The support of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (grants #R21HD048257, R01HD058365 R01HD058365-03S1) is gratefully acknowledged.

Introduction

Ensuring universal institutional deliveries is an important challenge of rural maternal and child health (MCH) care systems in resource-limited settings. Even in settings where maternal and child health care is heavily subsidized or free, a substantial proportion of women do not deliver at health facilities thereby jeopardizing their health and that of their babies. While some of these women choose not to deliver at MCH clinics instead opting for assistance of non-professional providers in their communities, others are unable to reach a clinic in time due to distance and transportation unavailability or costs (Gabrysch et al. 2011). Studies also point to the role of women's education and household economic conditions (Idris et al. 2006; Nwakoby 1994), cultural norms (Seljeskog et al 2006) and of social influences in the household and the community (Amooti-Kaguna and Nuwaha 2000). Experienced or perceived quality of care is said to be a big factor in women's choice of health facility for delivery or for delivering outside clinic (Amooti-Kaguna and Nuwaha 2000; Kruk et al. 2009), but quality of care is also notoriously difficult to measure (Gabrysh and Campbell 2009). Finally, spatial inequalities in the availability of delivery care have been noted as a major determinant of place of delivery (Johnson et al. 2009).

This study builds upon this literature to examine factors affecting women's choice of clinics for delivery and factors underlying non-institutional delivery in a rural setting in Mozambique. It aims at developing an explanation for clinic choice and for non-institutional deliveries that takes into account women's and their households' socioeconomic characteristics, the distance from their residences to MCH facilities, the spatial clustering of these facilities relative to individuals' residences, organizational characteristics of those facilities, and the role of

expanding integration of HIV services into existing MCH clinics. Given the high levels of HIV prevalence in the study area – approximately 25% of adults are estimated to be seropositive – and the rapidly changing availability of HIV testing and treatment services, women’s evaluation of their own likelihood of infection and of its consequences for them and their children and of the HIV services available to them are likely to have a strong impact on decisions about where to give birth and their willingness and ability to implement those decisions.

In this extended abstract, we describe the setting, data and methods and present preliminary results from descriptive spatial statistics and baseline logistic regression models. The full paper will incorporate additional individual and clinic-level characteristics into multivariate models.

Setting

The study utilizes data from a longitudinal household survey in rural southern Mozambique, an impoverished nation of 24 million in southeast Africa with a GNI per capita of US\$470. The study area includes four contiguous districts with a total area of c. 6000 sq. m. and a population of some 650,000 (see Figure 1). The setting is largely monoethnic and patrilineal. The mainstay of local rural economy is subsistence agriculture. Low and unpredictable agricultural yields, paucity of non-agricultural employment opportunities, and the proximity of South Africa, Mozambique’s much more developed neighbor have all contributed to a large scale male labor out-migration. The area is characterized by high fertility, with the total fertility rate around 5 children per woman, and very high adult HIV prevalence, c. 25%.

MCH and other reproductive and sexual health care services for rural women are provided through a network of clinics run by the Ministry of Health. All these clinics provide MCH care

services as well as HIV prophylaxis and treatment completely free of charge. Women are also free to receive prenatal care and have deliveries in a clinic of their choice.

Data and Method

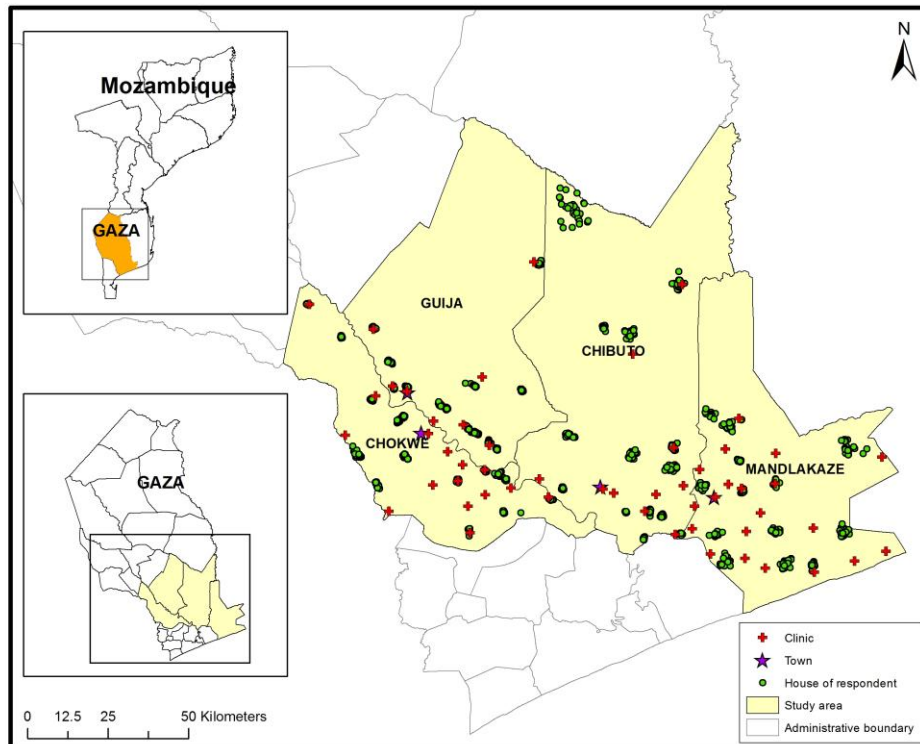
Data

The data come from three waves of a population-based survey. In the first wave, 1680 women aged 18-40 married to migrants and non-migrants were selected through multi-stage probability sampling in 56 villages of four contiguous districts of Gaza province. About 30 women were interviewed in each village in the first survey wave. The women were reinterviewed in 2009 and then in 2011. The retention rate between the first and last waves of the survey for surviving women was 81% and the participation rate exceeded 95%. Women who could not be reinterviewed in either of the last two waves because of migration outside the study area (typically across the international border to South Africa) or death were replaced through random sample refreshment. In each wave, the survey collected detailed information on respondents' and their households' demographic and socioeconomic characteristics. Respondents' detailed pregnancy and birth histories were also collected in each survey wave. Geographic coordinates of respondents' residences were also recorded.

In parallel with the women's survey, in all three waves, a community survey was carried out with leaders of each of the 56 villages. Finally, an annual survey of all MCH clinics in the four districts (n=53) was carried out between 2008 and 2011. For that survey, one or several nurses at each clinic were interviewed about the type and quantity of MCH services, patient flow and characteristics, and challenges in the provision of services. In addition, each clinic's monthly statistics on prenatal care, deliveries, PMTCT and other surveys were also collected. Figure 1

shows the location of survey respondents' houses and of the clinics in the study area. As can be seen the surveyed villages and clinics are predominantly concentrated in the southern part of the study area, reflecting the distribution of its population.

Figure 1. Location of survey respondents' houses and MCH clinics.



Methods

The study uses a combination of spatial analysis and GIS techniques with logistic regression. First, exploratory spatial data analysis (ESDA) is employed to explore spatial patterns of institutional and non-institutional child delivery. ESDA represents a collection of techniques to describe and visualize spatial patterns by graphic and map-based visualization and to facilitate hypotheses formulation and testing (Anselin, 1994, 1998; Murray, 2010). Specifically, ESDA

allows us to explore the outcome of interest for spatial clustering using the spatial scan statistics based on a probability model (see Rogerson and Yamada, 2009). It employs a scanning window of predefined shape (circular or elliptical) and variable size that moves over the entire study area to detect whether the rates inside the window are unusually higher than those outside of the window using a log-likelihood ratio test. The spatial scan statistic used here is the Bernoulli model proposed by Kulldorff (1997) for binary data as the outcome has two possible values: institutional vs. non-institutional child delivery.

To explore spatial correlation at the community level, two spatial autocorrelation statistics, Moran's I and Local Indicator of Spatial Association (LISA) (see Anselin, 1995) are used. Moran's I is a commonly used statistic to assess global spatial autocorrelation for a given variable. The value of this statistic ranges from 0 to 1, where positive values indicate observations with similar values being close to each other and negative values suggest observations with high values are near those with low values, or vice versa. The LISA effectively decomposes a global measure of spatial autocorrelation for each spatial unit, enabling assessment of statistical significance for each unit. Accordingly, the global Moran's I is the mean of the local Moran's I.

In the next stage of the analysis, we employ multivariate logistic regression, which allows integrating the effects of spatial characteristics with those of individual respondents, their partners, their households, as well as characteristics of MCH clinics in the area. The multivariate analysis thus enables us to examine the complexity of women's access to clinics, which is shaped by spatial, social, and institutional factors. The final multivariate analyses will also take advantage of the longitudinal nature of the data allowing us to capture possible effects of the rapid scale-up of HIV services in the study area during the study period.

Preliminary Results

Exploratory spatial analyses

Whereas almost all women in the sample had at least one prenatal consultation during their last pregnancy, only 70% had their last deliveries at a MCH clinic. The map in Figure 2 shows the clinics where women surveyed in the 2009 wave who gave birth since the previous wave had their most recent deliveries. It is clear from the map that women do not necessarily deliver at closest clinics and women from the same villages often deliver their babies in different clinics. Also, some clinics, especially the four clinics located in towns (district headquarters), attract more women than others.

Figure 2. Clinics of delivery for survey respondents whose last deliveries took place in a MCH clinic (2009 data)

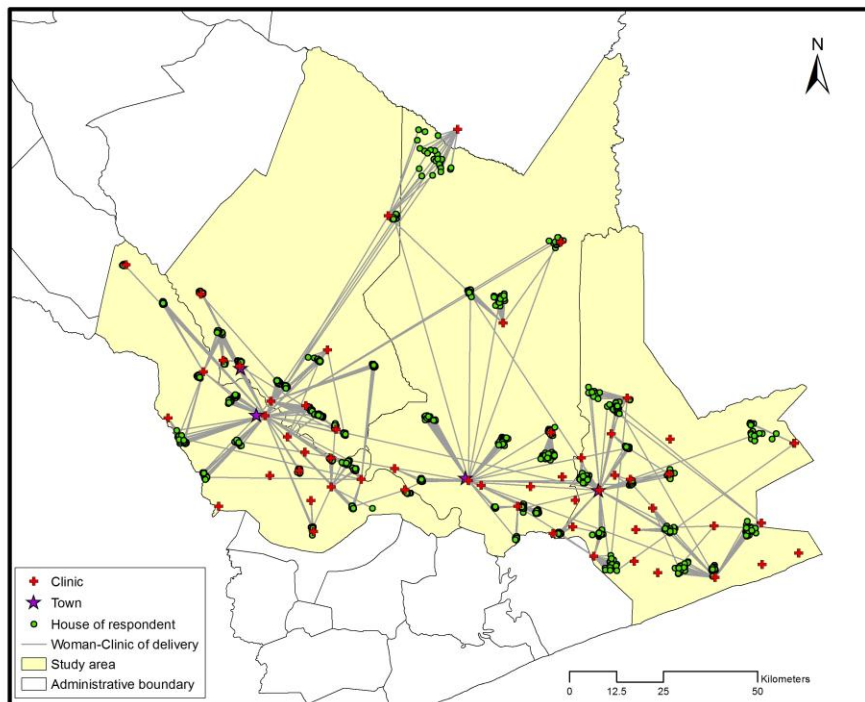
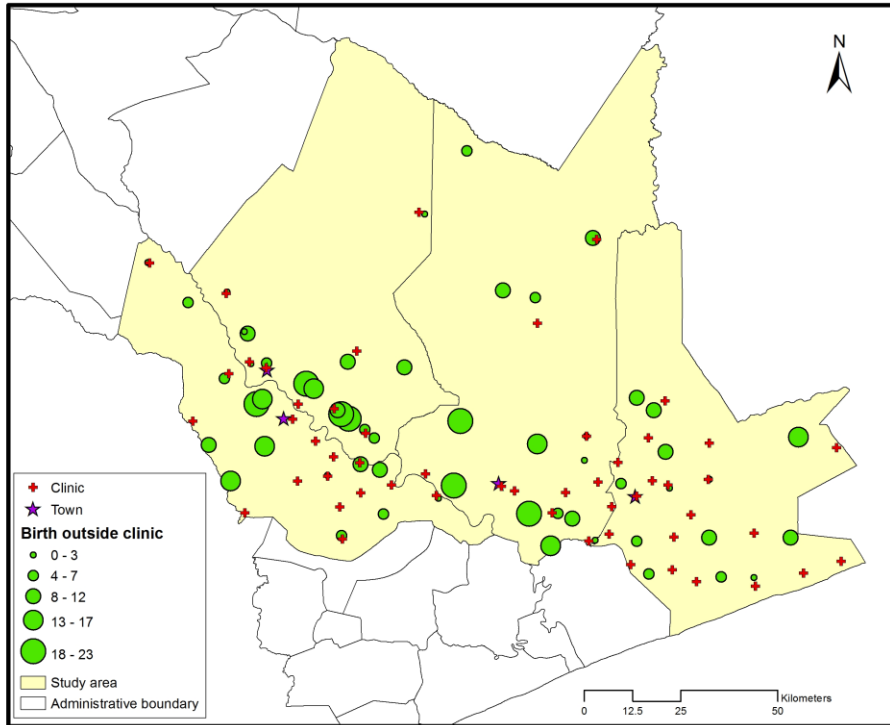


Figure 3. Non-institutional deliveries, 2009 (pregnancies in preceding three years)



Multivariate regression analyses

Table 1 presents results of multivariate logistic regression model predicting the probability of having the most recent delivery in a health facility among married women of the 2009 survey wave. Only women who had at least one prenatal consultation during the focal pregnancy (more than 98% of all women) and whose pregnancy ended in a live birth (information on place of delivery available for only live births) are included. The covariates include respondent's age, education, number of children prior to last birth, household material status, type of marriage, and husband's migration status. The model accounts for the number of prenatal consultations and for whether the woman had most of those consultations at the nearest clinic (as was mentioned earlier, practically all pregnant women in the sample had at least one prenatal consultation), and

whether she was tested for HIV, in a prenatal consultation or elsewhere since the previous wave. Finally, the model includes distance to nearest clinic and distance to nearest town (district headquarters) (final models will include additional relevant covariates and will account for both respondents' and clinics' clustering).

The results of this preliminary analysis show that more educated women and women from more affluent households are more likely to deliver at a clinic. Recent HIV testing also increases the likelihood of institutional deliveries. Type of marriage and husband's migration status do not have any effect on the probability of delivering at a MCH clinic; nor does the number and place of prenatal consultations. Most interestingly, while distance to nearest clinic is negatively associated with the probability of institutional delivery, distance to nearest town has a significant positive effect (to ensure that these last two effects are not due to a correlation between the two predictors, we estimated the same regressions with only one of them in the model; the effects of distance remain essentially the same as in the model presented in Table 1).

Next steps

The final multivariate analyses will incorporate additional independent variables, most notably characteristics of nearby clinics such as number of staff and level of resources (e.g., whether the clinic has access to electricity, piped water, or dedicated facilities for delivery). Preliminary results show that women who have recently been tested for HIV are more likely to deliver in clinics, suggesting a possible association between women's knowledge of their HIV status and their decisions about location for childbirth. Analyses will add both woman-level measures of perceived HIV risk and experience with HIV services and clinic-level measures of availability of HIV-specific services. In addition, models in the completed paper will account for the clustering

of respondents within village, and therefore for unobserved characteristics respondents living in the same village might share, and for the spatial clustering of clinics relative to respondents' residences. Finally, the full paper will take advantage of the longitudinal nature of the data. Pregnancies reported at all waves of data collection will be included in analysis, and time-varying measures will be used to account for changes in both women's and clinic characteristics, particularly characteristics related to women's perception/knowledge of HIV status and availability of HIV services at clinics.

Table 1. Logistic regression of having the most recent delivery at a clinic (married women with at least one prenatal consultation), 2009

Predictor	Coefficient	Std. Error
Age	0.024	0.014
Number of children	-0.129*	0.053
Mother's education	0.090*	0.027
Husband is a migrant	0.091	0.128
Polygamous marriage	0.122	0.155
Household status (4-level scale)	0.159*	0.062
Had an HIV test after 2006	0.409**	0.125
Number of prenatal consultations	0.003	0.003
Most prenatal consultations in the nearest clinic	-0.180	0.135
Distance from residence to town (km)	0.030**	0.005
Distance from residence to nearest clinic (km)	-0.127**	0.016
Intercept	-0.007	0.439
Number of observations	1457	

Notes: significance: $p < 0.01$: '***', $p < 0.05$: '*', $p < 0.1$ '+'; Reference categories: husband not a migrant, monogamous marriage, household material status 1 (lowest), did not have an HIV test after 2006, most prenatal consultations not at nearest clinic.

References

- Amooti-Kaguna, B & Nuwaha, F. 2000. "Factor influencing choice of delivery sites in Rakai district of Uganda" *Social Science & Medicine* 50: 203-213.
- Anselin, L. 1994. Exploratory spatial data analysis and geographic information systems. In M. Painho (Ed.), *New tools for spatial analysis* (pp. 45-54). Luxembourg: Eurostat.
- Anselin, L. 1995. Local indicators of spatial association - LISA. *Geographical Analysis* 27, 93-115.
- Anselin, L. 1998. Exploratory spatial data analysis in a geocomputational environment. In P. Longley, S. Brooks, B. Macmillan, & R. McDonnell (Eds.), *Geocomputation, a primer* (pp. 77e94). New York: Wiley.
- Gabrysch, S., & Campbell, O. M.R. 2009. "Still too far to walk: Literature review of the determinants of delivery service use" *BMC Pregnancy and Childbirth* 9:34
- Gabrysch, S., S. Cousens, J. Cox, O. M. R. Campbell. 2011. "The Influence of Distance and Level of Care on Delivery Place in Rural Zambia: A Study of Linked National Data in a Geographic Information System" *PLoS Medicine* 8 (1)
- Idris, S.H., U.M.D. Gwarzo, and A.U. Shehu. 2006. "Determinants of Place of Delivery among Women in a Semi-Urban Settlement in Zaria, Northern Nigeria." *Annals of African Medicine* 5(2): 68-72.
- Johnson, F.A., Padmadas, & S.S., Brown, J.J. 2009. "On the Spatial Inequalities of Institutional Versus Home Births in Ghana: A Multilevel Analysis" *Journal of Community Health* 34(1): 64-72

- Kruk, M.E., Paxzkowski, M., Mbaruku, G., de Pinto, H., & S. Galea. 2009. "Women's Preferences for Place of Delivery in Rural Tanzania: A Population-Based Discrete Choice Experiment" *American Journal of Public Health* 99 (9): 1666-1672
- Kulldorff, M. 1997. A spatial scan statistic. *Communications in Statistics: Theory and Methods* 26, 1487-1496.
- Murray, A. T. 2010. Quantitative geography. *Journal of Regional Science* 50,143-163.
- Nwakoby, B.N. 1994. "Use of Obstetric Services in Rural Nigeria" *Perspectives in Public Health* 114 (3): 132-136
- Rogerson, P. A., & Yamada, I. 2009. *Statistical detection and surveillance of geographic clusters*. CRC Press.
- Seljeskog, L., Sundby, J., & Chimango, J. 2006. "Factors Influencing Women's Choice of Place of Delivery in Rural Malawi-An Explorative Study" *African Journal of Reproductive Health* 10(2): 66-75