Does Antenatal Care Matter in the Use of Skilled Birth Attendance in Rural Africa: The Case of Ghana, Kenya, Tanzania and Uganda

Vissého D, Adjiwanou, *University of Montréal*
Thomas LeGrand, *University of Montréal*

The importance of the role and number of antenatal care visits in preventing mortality and morbidity continues to be debated (Campbell and Graham 2006; Evans and Lien 2005; McDonagh 1996, Villar et al, 2001). However, beyond their traditional role, antenatal care services can educate women about the merits of skilled birth attendance. In environments where the use of skilled birth attendants is very low, this role is anything but negligible. The use of skilled personnel at birth reduces the risk of death for the mother and the newborn (Ronsmans, Etard and Walraven 2003; Ronsmans and Graham 2006; Say and Raine 2007, Thaddeus and Maine 1994). Thus, antenatal care indirectly influence the survival of mothers and children. Some authors also believe that this influence may be direct, including increased birth weight (Goldani et al, 2004, Jewell and Rous 2009; Kotelchuck 1994), reduced intrauterine growth retardation (Coria-Soto, and Bobadilla Notzon 1996) or vaccination of children (Stevens-Simon, Kelly and Singer 1996).

Several authors have analyzed the link between the use of antenatal care services and delivery in a health facility or formal care setting (Barber 2006; of Allegri et al, 2011; Singh and Ram 2005; Rani, Bonu and Harvey 2008). This research is part of the broader context of the analysis of health behavior, which postulates that the use of a service creates externalities that enhance the future use of other services (Ahmed and Mosley 2002; Hotchkiss et al, 2005; Overbosch et al, 2004; Pallikadavath, Foss and Stones 2004, Seiber et al, 2005; Zerai and Tsui 2001). The aforementioned studies examined the two behaviors independently even though they recognized that the decision of women is more likely to be joint (Rockers et al, 2009) or subject to non-measurable factors (Stephenson et al, 2006). Other authors have used composite indicators between the three dimensions of antenatal care, namely the number, timing and quality (content) of services, to assess their overall influence on the subsequent use of the skilled birth attendants (Bloom, Wypij and Lippeveld 1999, Ram and Singh 2005). This approach did not permit to distinguish between the place of quality from the place of antenatal utilization on the use of skilled birth attendance.

We reviewed the relationship between antenatal care and subsequent childbirth with skilled staff by correcting for endogeneity problems. We used structural equation models by estimating a model (use of antenatal care) and two structural models (quality of

services received and use for childbirth with a skilled staff). These models thus described the mechanisms underlying this relationship.

Methodology

Our basic model estimated the effect of antenatal care on delivery with assistance from a skilled provider. It is written as:

$D_i = 1(P_i\pi_3 + Q_i\delta_3 + X_{3i}\beta_3 + \varepsilon_{3i} \geq 0)$, (Equation 3) where 1 denotes the indicator function. The variable D_i takes the value 1 if the condition in the parenthesis is true, X_{3i} focuses on individual and family variables of women and those on its immediate environment, P_i refers to antenatal care received and Q_i the quality of antenatal care. To correct the endogeneity problem, we use the structural equation approach (Cameron and Trivedi 2010) by estimating this equation simultaneously with the two following equations:

$$P_i = 1(X_{1i}\beta_1 + \varepsilon_{1i} \geq 0) \qquad \text{(Équation 1)}$$

$$\begin{cases} Q_i = 1 & si\ (P_i\gamma_2 + X_{2i}\beta_2 + \varepsilon_{2i}) < \alpha_1 \\ Q_i = 2 & si\ (\alpha_1 \leq P_i\gamma_2 + X_{2i}\beta_2 + \varepsilon_{2i}) < \alpha_2 \\ Q_i = 3 & si\ (\alpha_2 \leq P_i\gamma_2 + X_{2i}\beta_2 + \varepsilon_{2i}) < \alpha_3 \\ Q_i = 4 & si\ (P_i\gamma_2 + X_{2i}\beta_2 + \varepsilon_{2i}) \geq \alpha_3 \end{cases} \qquad \text{(Équation2)}$$

Q_i is the variable quality of antenatal care. $(\varepsilon_{1i}, \varepsilon_{2i}, \varepsilon_{3i})$ follows a multinomial normal identically distributed N(0,0,0, Σ). Σ is the variance-covariance matrix of error terms. This recursive system of equations is identified if the so-called exclusion criterion is met (Maddala 1983). Even if it is proved that the functional form of this system of equations (non-linearity of the relationship between X and Y) can be estimated without the exclusion criteria (Dong 2009, Marra and Radice 2011, Wilde 2000), it is always desirable to have at least one, especially in the presence of misspecification (Monfardini and Radice 2008; Roodman 2011).

Criteria for identification of the equation 2 (from equation 3) are easier to find. In our case, we selected two variables: the person who provided the antenatal care and where this care occurred. These two variables are likely to influence the quality of service without having any direct effect on the dependent variable of equation 3 (skilled birth attendance). For equations 1 and 3, we used as exclusion criterion variable "debut of antenatal care." This variable influenced the number of services received in the sense that the later in pregnancy that someone presented for care, the fewer antenatal visits they would be able to receive. However, this variable did not influence the use of trained personal at birth.

We estimate four different models. The model 1 is the simple probit model that doesn't correct for endogeneity. The model 2 is the bivariate recursive model between four antenatal care and skilled birth attendance (Only by estimation of equations 1 and 3). This model tests also for the endogenity by the statistics rho (correlation between the terms of error of the two equations). The models 3 tests if our exclusion criterium is valid (by the Minimum eigenvalue statistic). Finally, in the last model, we estimated the three equations simultaneously using the cmp command in Stata (Roodman 2011). We corrected the standard error due to the independence between individuals of the same cluster by the Huber-White procedure.

Data and variables

Data for this study came from the Demographic and Health Survey (DHS) of Ghana (2003), Kenya (2003), Uganda (2006) and Tanzania (2004-2005). A total of 3317 women aged 15-49 years were interviewed in rural Ghana. Of these, 1960 had at least one live birth in the last 5 years. In Kenya, Tanzania and Uganda, 5444, 7816 and 7081 women aged 15-49 years who were interviewed in rural areas respectively. Of these, 3019 women in Kenya, 4789 women in Tanzania and 4531 women in Uganda had at least one live birth in the last 5 years.

Three dependent variables were analyzed: (1) at least four antenatal visits, (2) skilled birth attendance and (3) quality of service received during antenatal care. The two variables of use were dichotomous and took the value 1 if the woman has had the kind of service for their last birth within 5 years prior to the survey. The last dependent variable was the quality of antenatal care received. It was therefore defined by the content of services provided to women. The content of services included information on complications, proper birth preparations and other services received such as taking blood pressure and weight of the woman. This variable was grouped into four categories ranging from 1 (quality 1) to 4 (quality 4), with a higher score denoting better service.

The main predictors of the use of maternal health services come from the framework developed by Andersen (Andersen 1968, 1995). Socio-demographic variables, such as the woman's age at the time of pregnancy, parity, level of education, employment status, marital status, religion and her relationship to head of household. We also took into account household characteristics (income quintile) and the characteristics of the partner (level of education and employment).

Results

The significance of the coefficient rho in Kenya and to a lesser extent in Tanzania shows that there are unobservable external factors that influence both the use of antenatal care and the use of childbirth with a skilled staff. The estimated coefficients from this model are always larger than in Model 1, a difference which is relatively large for Kenya

and for Tanzania. These results suggest that the standard model underestimates the effect of antenatal care on the use of childbirth with a skilled staff in both countries. In Kenya, the estimated marginal effects show that women who had at least four antenatal visits were 20% more likely to give birth with skilled staff than women who have had less than four visits. The increase is 17% in Ghana and around 10% in the other two countries.

Table 1: Effects of antenatal care and its quality on skilled birth attendance: evaluation of endogenity and validity of exclusion criterium

Countries	Models and their descriptions	Rho	Coefficient of regressions				
			ANC_4	Quality of antenatal care			Validity of instruments°
				Quality2	Quality3	Quality 4	Minimum eigenvalue statistic
	Model1 1: probit		0.66***	0.24°	0.23*	0.32**	
Ghana	Model 2 : recursive bi probit (CMP)	-0.00	0.67** (0,17)	0.26°	0.24*	0.33**	
	Modèle 3: recursive biprobit - IV+	-0.06	0.21**	0.03	0.02	0.06	193,73++
	Model 4 : Final model		0.70*	0.24	0.21	0.27	
	Model1 1: probit		0.26***	0.20*	0.37***	0.44***	
Kenya	Model 2 : recursive bi probit (CMP)	-0.30**	0.72*** (0,20)	0.20*	0.35***	0.42***	
	Modèle 3: recursive biprobit - IV+	-0.36**	0.29***	0.00	0.06°	0.07°	124,39++
	Model 4 : Final model		0.08	0.81***	1.25***	1.78***	
	Model1 1: probit		0.06	0.17*	0.11	0.35***	
Tanzania	Model 2 : recursive bi probit (CMP)	-0.18	0.34° (0,11)	0.16*	0.11	0.34***	
	Modèle 3: recursive biprobit - IV+	-0.15°	0.12*	0.05*	0.03	0.10***	230.32++
	Model 4 : Final model		-0,02	0.64***	0.78***	1.41***	
	Model1 1: probit		0.32***	0.17*	0.19**	0.31***	
Uganda	Model 2 : recursive bi probit (CMP)	-0.00	0.32* (0,10)	0.17*	0.19**	0.31***	
	Modèle 3: recursive biprobit - IV+	-0.01	0.11*	0.05*	0.06**	0.09***	325.40++
	Model 4 : Final model		-.04	0.50***	0.80***	1.36***	

°Wald test of exogeneity; + the coefficients must be multiplied by 2.5 to be compared with coefficients of model 2; ++ statistics greater than the limit of 16,38; marginal effects in brackets. Significance at 10% (°), at 5 % (*), at 1 % (**) and at 0,1 % (***).

Model 3 uses instrumental variables approach is along the same lines as the results from Model 2. This model also allows us to test the relevance of the instrument. Thus, assuming that we accept at most a rejection rate of 10% of a Wald test of 5%, we can reject the null hypothesis that the instrument is low, since the test statistic (Minimum eigenvalue statistic) far exceeds its critical value of 16.38 in the four countries (STATA 2010; Stock and Yogo 2005).

The table 1 shows also that the quality of service received during antenatal care plays an important role in the decisions of the woman on the type of service use during childbirth. In all countries, we find that the quality of care received during antenatal care has a positive influence on the use of skilled birth attendance. Models 1 to 3 consider this additive effect. However, it is possible that the effect of the quality itself depends on the number of services received and that this quality of antenatal care may be itself endogenous. The latest model 4 takes into account the both endogeneity (of number of antenatal care and the quality of service), but also the mediating effect of the quality of antenatal care. This model shows an accentuation of the effect of the quality of antenatal care in Kenya, Uganda and Tanzania. These results show that, in these countries, this effect is largely mediated by the quality of services offered to women during antenatal care. In Ghana, only the number of antenatal care remains significant.

These findings strongly suggest that governments and NGOs should place more importance on the role of the providers and the quality of care offered, in their efforts to promote skilled birth attendance.