An Analysis by Structural Equation Modeling of Contextual Determinants of the Use of Maternal Health Services in Africa

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Despite the onset of demographic transition in the 1950s, the fertility level is still high in many African countries. As a result, the burden of maternal mortality and morbidity related to pregnancy will continue to hamper the achievement of Goals 4 and 5 of the Millennium Development Goals (MDGs). This is largely due to the non-use of health services during pregnancy and delivery (Amooti-Kaguna and Nuwaha 2000; Bhatia and Cleland 1995; Caldwell and Caldwell 1993; Degraff, Bilborrow and Guilkey 1997; Koblinsky 1995; Obermeyer 1993; Overbosch et al. 2004). Although individual factors play a central role in health behaviors (Andersen 1995; Pebley, Goldman and Rodriguez 1996), the need for the inclusion of community factors continues to grow (Behrman, Kohler and Watkins 2002; Entwisle et al. 2007; Franzini et al. 2005; Gage 2007; Sampson 2003; Stephenson et al. 2006; Stephenson and Tsui 2002; Subramanian 2004; Wen, Browning and Cagney 2003).

The theoretical explanation of the effect of context on individual health behaviors theorizes a complex relationship between different levels of analysis (Bilsborrow & Guilkey, 1987; Franzini et al, 2005; Gage, 2007, Stafford and al,, 2008, Stephenson et al, 2006). In developing countries, a favorable environment for the empowerment of women is likely to positively influence their autonomy and their relationship to health service (Caldwell & Caldwell, 1993; Desai & Johnson, 2005; Mason, 1987; Stephenson et al, 2006). However, these relationships are often not revealed through classical multilevel regressions (Franzini et al, 2005; Stafford et al, 2008). Another problem that researchers face is the construction of community level variables (Riva et al, 2007).

Using data from Demographic and Health Surveys in four African countries, we developed a general framework for analyzing contextual determinants of the use of maternal health services. We measured environmental empowerment using latent variable approach (Raudenbush 2003). We used latent structural equation models, which offer a better account of the context (as latent variables) as well as an assessment of direct and indirect effects (Stafford et al., 2008). We used these models to estimate the effect of context on childbirth with a trained provider. We postulate that context has a direct influence on use of services and an indirect effect through the individual autonomy of women.

Data

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. Like other studies, we identified the neighborhood by the cluster of the survey (Montgomery & Hewett, 2005).

Variables

We had two variables at the individual level. The primary dependent variable was the presence of a skilled provider during childbirth. This variable took the value 1 if the woman gave birth with qualified personnel. The second dependent variable was women autonomy, which was a mediating variable. This variable was an index that was constructed using the answers to four questions asked to women about the person responsible for decision making in several areas within the household. This index took three values: 0: if the woman does not make any decisions (lack of autonomy), 1: if a woman takes 1-2 decisions (low autonomy) and 2: if the woman takes more than three decisions (high autonomy). Thus, with three terms, we opted for an unordered multinomial model, given that it does not seem to exist a natural order between these modalities. We compared the autonomy of women to that of women without autonomy and subsequently compared women with high autonomy to women with low autonomy.

Finally, the model had one community dependent variable. This was the latent variable that measured neighborhood empowerment (neighborhood women autonomy). It was measured by five indicators that addressed violence against women. Each question was aggregated at the cluster level. We calculated five indicators that measured the proportion of women who think that women could be beat: 1) if she went out without the permission of her husband, 2) if she neglected children, and 3) if she argued with her husband and 4) if she refused to have sex with her husband and 5) if she burned the food during cooking. A high score for a given indicator indicates an environment where a large proportion of women said that women should be beaten. These indicators were then used to construct the latent variable.

The independent variables related to the cluster are the socio-economic variables. We therefore used the proportion of households in quintile 3 or more, the proportion of women who have secondary or higher education, and the proportion of women who do not work in agriculture. Moreover, based on findings from several authors, we considered the influence of four variables that are related to fertility and to the use of services. These variables are related to high fertility (Stephenson et al., 2006) and include 1) the average number of children under 5 years per household in each cluster and 2) the proportion of women who do not use contraception. Two other variables relate to the social barriers that may discourage women from seeking prenatal care. These include: 1) the proportion of women who think that the non-presence of women as midwives is a major problem for their use of care (Beninguisse, 2003), and 2) the proportion of women

who think that it is a big problem for them to seek maternal care alone (Andrist & Desai, 2010). All community variables were divided into three quartiles.

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

Statistical methods

For the analysis, we used multilevel structural equation models. These models are a synthesis of multilevel models and structural equation models (Rabe-Hesketh et al, 2006). Models of multilevel analysis are appropriate to reflect the grouping of statistical units in larger cluster (Snijders & Bosker, 1999). The latent structural equation models are used to model variables that are not directly measurable from observable indicators.

To estimate this model, we used the software Mplus 6.11 (Muthén & Muthén, 1998-2010). The standard errors are estimated by the method of maximum likelihood estimator from the MLR algorithm maximizing the expectation (3 Expectation - Maximization algorithm). This is an approach called "full information estimator" which is more efficient than sequential estimation (Gottfredson et al, 2009; Kaplan, 2009).

Results

Factor analysis of the five indicators of cluster empowerment variables (neighborhood women autonomy) confirmed the presence of a unique factor (KMO> 0.8; one eigenvalue well above 1). After adjustment of the measurement model, the indices of the model were satisfactory. The RMSEA is below .04 in all countries, the CFI and TLI are both in excess of .99 and SRMR less than .07. Loadings are mostly above 0.7.

The results showed that the education of the community had a positive and significant influence on the use of skilled attendants at birth in Kenya, Uganda and Tanzania. Specifically, a woman living in an environment where the average years of education is high (upper quartile of the proportion of women of secondary education) was almost two times more likely to deliver with qualified personnel than a woman who lived in a community with low education (odds ratios are 1.8 in Kenya, Uganda 2.0 and 1.6 in Tanzania). In Ghana, the socio-economic variable that influenced the use of health care was the proportion of non-farm households. The higher this proportion was in a given environment, the more likely women were to use trained personnel for delivery. The income of the

community did not have a significant effect on the use of skilled birth attendants in the four countries.

Contextual norms related to fertility have different effects in different settings. Communities where a high proportion of women use modern contraception are also more likely to deliver with skilled staff in Kenya. In Uganda, where women perceive that it is difficult for them to get individual care, they also under used qualified staff for the delivery. However, this norm had no significant effect on the use of health services in any other countries.

Contextual norms related to women empowerment or autonomy had no direct effect on the use of skilled birth attendance in any country. However, our results showed that this variable had a negative effect on the women individual autonomy. Thus, one unit increase in the level of community autonomy increased the risk of a woman to leaving group 1 (high autonomy) for group 3 (lack of autonomy). The relative risks ranging from -2.1 to -3.6 from Tanzania to Uganda. In addition, individual autonomy did not increase the use of trained personnel during delivery.

Our hypothesis is that beyond these direct effects, the context also indirectly influences the use of maternal services through women's empowerment. We used Sobel's formula to determine the existence of an indirect effect of contextual norms of autonomy on the use of services. The results show that contextual autonomy had no significant indirect effect on the delivery with a skilled provider in the four countries studied.

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