# Antenatal Care Service Availability and Utilization in Rural Viet Nam

*Notwithstanding the limitations of data in measuring access and quality of ANC services, the findings of this study still reveal gaps in ANC service utilization among rural women despite seemingly high service coverage.*

By Mai Do*

Studies of determinants of reproductive health service utilization  maternal health services in particular  in developing countries have traditionally focused on individual-level factors. More recently, policymakers, programme managers and researchers have become interested in the influence of the quality of health-care services on service utilization. The availability of survey data that include information on individuals as well as the community and service environment allows researchers to examine the impact that of community-level factors,

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including the availability of and accessibility to service providers, have on utilization.

It is often found that the availability and accessibility including economic and time costs of maternal health services, notably delivery care, are related to service utilization. However, the effects of these factors on the likelihood that a woman would seek care during pregnancy are not as well documented. Physical access to a maternal health service provider has been found to be an important determinant of utilization in several studies. In Uttar Pradesh, India, it was found that the presence of health services in the community significantly increased the use of antenatal and delivery services (Stephenson and Tsui, 2002). In Guatemala, it was shown that the likelihood of antenatal care significantly diminished for women who lived further away from a government-sponsored clinic (Pebley, Goldmand and Rodríguez, 1996). Glei, Goldman and Rodríguez (2003) found in the same country that the effects of the availability of private and public sector providers on the use of biomedical care during pregnancy were modest compared with those of individual socio-economic factors and that such availability was unlikely to produce dramatic effects without additional changes in quality of services. In a qualitative assessment of barriers to maternal healthcare in India, Griffiths and Stephenson (2001) found that although socio-economic situation became less of a barrier to service utilization when services were within reasonable distance, quality of services, particularly in government facilities, remained an important factor for individuals deciding on service use. In such cases, improved access to and availability of services may not be sufficient to promote service utilization across socio-economic groups (see also Valdivia, 2002).

Although the body of literature is rich elsewhere, evidence of the impact of maternal health services on utilization in Viet Nam is almost non-existent. Meanwhile, the Government of Viet Nam has made sizeable investments into improving the geographical coverage of health facilities in the country. Anecdotal evidence shows that, in many areas, the number of private health-care providers and facilities has also been increasing. Increased availability of maternal health services should theoretically promote overall utilization. However, there has been no examination of the impact of accessibility and availability on maternal health service utilization. To the author's knowledge, there is only one published study, based on the 1988 Viet Nam Demographic and Health Survey, which found that lack of transportation and absence of prenatal care services in rural areas explained the lower prenatal care utilization observed in these areas (Swenson, and others,1993). This article aims to assess the linkages between maternal health

service's accessibility and availability  particularly that of antenatal care (ANC) and service utilization in Viet Nam.

Viet Nam has witnessed much progress in antenatal care in the past two decades. The proportion of pregnant women who seek care from a trained provider (a physician, nurse or midwife) increased dramatically from 55 per cent in 1990-1994 to 71 per cent in 1995-1997 and 86 per cent in 2000-2002 (Viet Nam, 1995; Viet Nam, 1999; Viet Nam and ORC Macro, 2003). However, the differences in the use of maternal health services between urban and rural areas remained notable. Data from the Viet Nam Demographic and Health Survey 2002 (2003) show that while ANC in urban areas was universal (96 per cent of pregnant women received at least one ANC visit by a trained provider), only 84 per cent of pregnant women in rural areas received such a visit. There was some evidence that a woman's education increased the likelihood that she would seek ANC. In urban Viet Nam, ANC is widely used and service availability is not deemed a possible barrier to its utilization. Therefore, this article focuses on service availability and utilization in rural areas.

The present study will respond to the following research question: What are the impacts of service availability in public and private sectors on the use of antenatal care in rural Viet Nam? It will also investigate whether socio-economic inequality in service utilization is reduced by the availability of ANC services in these two sectors.  Outcomes of interest are: (a) timing of the first ANC visit (whether it occurred within the first trimester) and (b) number of such visits during the pregnancy (if there are three or more visits). It is expected that the study will contribute to the understanding of how health-care behaviour is influenced by the availability and accessibility of services from both the public and private sectors. The results will assist policymakers in developing strategies to promote service utilization and improve equity in healthcare.

## Data and methods

Data for this study come from the Viet Nam Demographic and Health Survey 2002 (DHS). This is a nationally representative survey of 5,665 ever-married women aged 15-49 years, selected from 205 clusters throughout the country. Data on pregnancy and antenatal care came from questions asked to women about their live births since January 1999. For each live birth that occurred between January 1999 and the interview date, the woman was asked how many months pregnant she was when she first received ANC, and how many times she received such care during that pregnancy. A total of 1,321 live births occurred during the time interval, of which 1,085 live births occurred in rural areas. The analysis is restricted

to rural women because it is not expected that the availability of services would make a difference in urban areas, where ANC is universal. In addition, the analysis was also restricted to single births as the outcomes may not be as appropriate for multiple births. If a pregnant woman is thought to carry two or more foetuses, she might be strongly encouraged by health service providers to have more frequent and possibly more comprehensive ANC visits. Thus, the examination of the timing, and particularly the frequency of ANC visits for women with multiple births would differ from that of women with single births. As a consequence, 43 multiple births were excluded, resulting in a sample of 1,042 single live births since January 1999 available for analysis.

Data on community characteristics and the availability and accessibility of ANC services were obtained from the Community Questionnaire, which was administered to key informants in the clusters selected for interview. The information collected with the questionnaire includes socio-economic development of the community, distance to the nearest urban centre, schools, markets, shops, types of health services (including ANC) that are available and the travel distances and times to such health facilities.

**Dependent variables**

Two outcomes are examined in this study: the timing of the first ANC visit and the number of ANC visits during the index pregnancy. The Viet Nam National Strategy on Reproductive Health Care for the 2001-2010 period recommends that pregnant women initiate ANC within the first trimester and receive at least three ANC visits during their pregnancy. The outcomes, therefore, are two binary measures: whether the first ANC visit occurred within the first three months of pregnancy and whether there were three or more such visits during the pregnancy. In addition, if a woman initiated ANC within the first three months of her pregnancy and continued on to have three or more such visits over the course of her pregnancy, she is considered as having received appropriate ANC. Data for the two binary measures came directly from responses to two questions posed for each pregnancy since January 1999: "How many months pregnant were you when you first received antenatal care?" and "How many times did you receive antenatal care during this pregnancy?".

**Independent variables**

Individual-level factors included in the present analysis are: household wealth, age of women at the time of childbirth, order of index pregnancy, wantedness of index pregnancy, women's education, exposure to mass media (newspapers, radio and TV), ethnicity and number of years that respondents have lived in the current community.

Household wealth was pre-constructed by ORC Macro based on such criteria as the possession of a number of household assets, construction materials for walls, roofs and floors. In the present study, household wealth is used as a proxy for socio-economic status and inequality is measured by relative differences in service utilization across household wealth quintiles. Wealth quintiles based on wealth indices from household asset data have been widely used and shown as a good proxy for economic status (Bollen, Glanville and Stecklov, 2001; Filmer and Prichett, 2001; Rutstein and Johnson, 2004; Wagstaff and Watanabe, 2003).

Age of women at the time of childbirth was obtained based on age at time of interview and date of childbirth. Order of the index pregnancy comes directly from the birth history included in the DHS, while pregnancy wantedness is directly taken from responses to the question: "At the time you became pregnant with [NAME], did you want to become pregnant then, did you want to wait until later, or did you want no (more) children at all?". Several studies have suggested that parity or the order of the index birth, and the wantedness of pregnancy were strongly associated with the probability of the mother's receiving ANC services during pregnancy (see for example Celik and Hotchkiss, 2000; Magadi, Madise and Rodrigues, 2000; Pebley, Goldman and Rodriguez, 1996; Stephenson and Tsui, 2002). The author's preliminary analysis showed no differences in outcome between first, second and third children (data not shown). For this reason, the statistical differences were examined only between two groups: childbirths that were above the third order and those of the third order or below. The number of years respondents had lived in the community suggests a certain stability among respondents in terms of residence. It is thought that women who reside in the same community for a longer period of time are more likely to be influenced by the characteristics of that community as well as by neighbours and the normative behaviours prevailing there.

Community-level factors include: the concentration of high socio-economic status (SES) households, the concentration of highly educated women, whether telephone service is available within the community, type of road linking the community to the nearest urban centre, as well as the presence of a private doctor and any public sector health facility that offers ANC services within a 5-kilometre radius. The first four factors represent the level of socio-economic development of the community, while the last two variables measure ANC service availability within the community. The measurements related to high SES households and the concentration of highly educated women were constructed based on individual measures of household wealth and education of women. The data were averaged to the community level, excluding the index woman the inclusion of the index

woman in the aggregation of individual measures would have led to an inter-correlation between individual- and community-level variables, which could have resulted in a downward bias of the effects of either or both variables on individual outcomes (Shieh and Fouladi, 2003). Such a bias is thus minimized by the exclusion of the index individual. In addition, the inclusion of both individual- and community-level measures of education and wealth (as discussed below) also helps avoid biases and confounding effects that may be associated with models that use only aggregate measures (Greenland, 1992; Greenland, 2001; Wakefield and Salway, 2001).

Health facilities run by the Government of Viet Nam in rural areas referred to in this study are mostly commune and inter-commune health centres. These health centres are important components of the health system in Viet Nam. Since the 1950s, the Government has invested in the primary health-care system and has strived to establish a commune health centre in each and every community. Thus throughout the country, most of the 10,000 communities now have a commune health centre, whose services include family planning and basic maternal and child health-care. Intercommune health centres are the next level in the health system and are responsible for health care service provision in several contiguous communes.

## Table 1. Description and distribution of independent variables

| Variable | Description | Categories | Percentage or mean (standard deviation) |
|---|---|---|---|
| **Individual-level variables** | | | |
| Household wealth | Asset score pre-constructed by ORC Macro, typically based on principal component analysis: source of drinking water, type of toilet, floor materials, roof materials and the availability of a number of household asset items. Households were categorized into quintiles. | • First (poorest)<br>• Second<br>• Third<br>• Fourth<br>• Fifth (richest) | 29.8<br>26.9<br>20.6<br>15.4<br>7.3 |
| Age of respondent at the time of childbirth | Age of respondent at the time of childbirth (in past three years), constructed based on current age and time interval from childbirth to date of interview. Respondents were categorized into three age groups. | • 15-24 years old<br>• 25-29 years old<br>• 30-49 years old | 47.2<br>30.9<br>21.9 |

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**Table 1** *(Continued)*

| Variable | Description | Categories | Percentage or mean (standard deviation) |
|---|---|---|---|
| Ethnicity | Dichotomous variable indicating ethnicity of women: Vietnamese (Kinh) or other non-Vietnamese group. | • Vietnamese<br>• Non-Vietnamese | 77.3<br>22.7 |
| Order of index birth | Dichotomous variable indicating order of index childbirth in the past three years: whether it was a fourth- or higher-order child or not. | • First to third child<br>• Fourth child or above | 88.5<br>11.5 |
| Wantedness of birth | Dichotomous variable indicating wantedness of index pregnancy: whether the child was wanted at the time of the pregnancy or not (i.e. the pregnancy was wanted later or no more child was wanted at that time). | • Wanted then<br>• Wanted later/ wanted no more | 74.1<br>25.9 |
| Education | Categorical variable indicating highest educational level that respondents completed. | • No education<br>• Primary<br>• Secondary or higher | 9.3<br>29.6<br>61.1 |
| Read newspaper | Dichotomous variable indicating whether respondents read newspaper at least once a week. | • No<br>• Yes | 77.7<br>22.3 |
| Listen to radio | Dichotomous variable indicating whether respondents listen to the radio everyday. | • No<br>• Yes | 49.3<br>50.7 |
| Watch TV | Dichotomous variable indicating whether respondents watch television at least once a week. | • No<br>• Yes | 21.1<br>78.9 |
| Time lived in the community | Continuous variable indicating number of years respondent has lived in the same community. | • Number of years (mean, standard deviation) | 19.3<br>(12.1) |
| **Community-level variables** | | | |
| Concentration of high socio-economic status (SES) households | Dichotomous variables indicating whether the proportion of households of higher SES status (two highest wealth quintiles) in the community is high or low (cut-off at mean proportion). | • Low<br>• High | 67.1<br>32.9 |

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**Table 1** *(Continued)*

| Variable | Description | Categories | Percentage or mean (standard deviation) |
|---|---|---|---|
| Concentration of highly educated women | Dichotomous variable indicating whether the proportion of respondents with at least secondary school in the community is high or low (cut-off at mean proportion). | • Low<br>• High | 60.3<br>39.8 |
| Telephone service | Dichotomous variable indicating whether there is telephone service in the community. | • No<br>• Yes | 28.5<br>71.5 |
| Type of road | Categorical variable indicating type of road from the community to the nearest urban centre. | • All weather road<br>• Seasonal road<br>• Others (river/railway, dirt path, etc.) | 70.9<br>11.3<br>17.8 |
| Private doctor providing ANC services within a 5-km radius | Dichotomous variable indicating whether there is a private doctor who provides ANC services within 5 km of the community. | • No<br>• Yes | 86.6<br>13.4 |
| Public sector health facility providing ANC services within a 5- km radius | | • No<br>• Yes | 9.2<br>90.8 |
| **N** | | | **1,042** |

## Statistical models

Multivariate logistic regressions are used to estimate the effects of service availability on the binary outcomes, controlling for individual and other community characteristics. In addition, multilevel modeling is employed because of the hierarchical structure of the data. Theoretically, it is possible for one woman to have given birth more than once during the time period (between January 1999 and the interview date, which was three years or more). Furthermore, more than one woman was selected for interview in each of the selected clusters. Women who have been living in the same community may share observed and unobserved characteristics of the community, which in turn may influence their care-seeking behaviour during pregnancy. Therefore, antenatal care behaviours among women

who live in the same community are not independent. Multilevel modeling in this case is the appropriate method to employ as it can account for the interdependence of observations made within a single cluster (Goldstein, 1995).

Preliminary analysis showed that, of the 991 rural women who had at least one live birth during the period under study, the vast majority had only one live birth during that interval. Only 9 per cent had a second or higher live birth during that period. This low number of multiple births did not permit three-level modeling; consequently the individual level was ignored and two-level analyses were performed for each outcome. Factors that were hypothesized to influence antenatal care-seeking behaviour were modeled at level 1 (pregnancy level) and level 2 (community level). The two-level models took into account unobserved characteristics of communities that may influence individual antenatal care behaviours and allow more precise estimates of the effects of observed community-level variables. All analyses were carried out with the Stata 9.2 (Special Edition) package (StataCorp, 2005).

## Results

The study sample included 1,042 single live births having occurred to rural women from January 1999 to the time of interview (an interval of about three years). The distribution of these women is presented in the last column of table 1. More than half of the sample were in the two poorest quintiles; few women (7 per cent) were in the highest SES group. Nearly half of the women interviewed who had given birth were young: under 25 years of age at the time of childbirth. Just over three quarters of the sample (77 per cent) were Vietnamese (Kinh). Most women (89 per cent) had no more than two children before the index child, while just over 10 per cent of the respondents had given birth to a fourth or higher order child. When asked about wantedness of their child born within three years before the interview, three quarters of the women reported that their child was wanted at the time of pregnancy. A significant proportion of them (25 per cent), however, would have preferred to give birth at some later point in time or not to have given birth at all, indicating a marked prevalence of unplanned childbirth among rural women in Viet Nam.

Most women in the sample had had at least some schooling: 61 per cent of them had completed at least secondary school, while only 9 per cent had not received any schooling. Regarding exposure to mass media, television was most widely used: 79 per cent of the women watched TV at least once a week; half listened to the radio every day and just 22 per cent read newspapers every week. Rural women seemed to have been long-term residents of their community. At the

time of the survey, a rural woman, on average, had lived in the same community for 19 years, which was probably the major part of her life.

The distribution of community-level characteristics shows large proportions of women at a lower socio-economic level: two thirds lived in communities that were poorer than average and 60 per cent lived in communities with lower than average female education levels. A significant 29 per cent of women lived in a community without any telephone connection–an indication of isolation, lower socio-economic development and also a suggestion of lack of communication means, so crucial when facing an emergency. A similar proportion of women lived in communities cut off from any nearby urban centre: 30 per cent could travel to town only using roads that were seasonally accessible or difficult to travel. ANC service availability within the public sector did not seem a problem: the vast majority (91 per cent) of women lived within 5 km of a public sector facility providing ANC services. Private doctors with ANC services, by contrast, were rare: only 13 per cent of the women lived within 5 km of such a doctor.

**Table 2. Distributions of timing of first ANC visits and number of ANC visits during a recent pregnancy, Viet Nam, 2002**

| Timing of first ANC visit | Percentage |
|---|---|
| No ANC visit | 15.3 |
| First trimester | 53.0 |
| Second trimester | 24.0 |
| Third trimester | 7.7 |
| **Total** | **100.0** |
| **Number of ANC visits** | **Percentage** |
| No ANC visit | 15.4 |
| One or two visits | 31.8 |
| Three or more visits | 52.8 |
| **Total** | **100.0** |

Table 2 presents the distribution of two outcomes of interest regarding these births. A small but significant proportion of pregnancies took place without any antenatal care provided (15 per cent). Just over half of the 1,042 pregnant women received the first ANC visit during the first trimester of their pregnancy as recommended; nearly a quarter of them had their first ANC visit during the second trimester, while a few waited until the last trimester to initiate antenatal care. The proportion of pregnancies that received at least three antenatal visits as

recommended, by contrast, was similar to that of pregnancies that initiated ANC during the first trimester (53 per cent). In fact, many of those women (76 per cent) who received the first ANC visit within the first three months of their pregnancy also received at least three ANC visits. Those women account for 40.3 per cent of all the women who received appropriate ANC care (i.e. appropriate timing and frequency of ANC visits). Despite high coverage of ANC services, more than half of the pregnant women in rural areas in Viet Nam did not receive appropriate services in terms of either timing or number of visits during a pregnancy or both.

**Bivariate analysis**

Table 3 shows the results of the preliminary analysis for timing and frequency of ANC visits with each independent variables; other factors hypothesized to influence ANC service utilization were not controlled for.

Both timing and frequency of ANC visits differed for most individual characteristics, except the number of years that women had lived in the community. Higher proportions of women having an ANC visit within the first trimester of the pregnancy and three or more ANC visits were found among women of higher wealth quintiles, among those who were more highly educated, who were Vietnamese (as compared with other ethnic groups) and who had had more exposure to the media (newspapers, radio and TV); the probability of such visits was also higher in these groups. Women who were older at the time of the delivery, those who were bearing fourth or higher order children and those whose pregnancy was unplanned were found to have a lower proportion of having ANC visits in the first three months more than three ANC visits during the index pregnancy. The bivariate analysis with years of residence in the community did not reveal any significant differences.

Similarly to differences by individual characteristics, the timing and frequency of ANC visits also differed by SES and education levels of the community, as measured by the proportion of households with high SES and with highly educated women. Higher proportions of women having received ANC visits during their pregnancy within the first three months and having received at least three ANC visits were found in communities with a higher than average proportion of households of high SES and women with at least secondary schooling. The proportions of both outcomes of interest were also higher (by at least 50 per cent) in communities equipped with telephone services. In terms of remoteness of rural communities, those with seasonal road access to the nearest urban centre had the lowest proportion of women who made ANC visits within the first trimester, as well as of women who received three or more ANC visits during a

recent pregnancy. Women in communities with easy (i.e. all-weather) road access did not do much better than those who had to travel to an urban centre via boat or railway. Analysis by service environment characteristics, however, shows that ANC service utilization did not vary by service availability in the private sector, while much higher proportions of women who made ANC visits within the first three months or had three or more ANC visits were seen in communities with ANC services available in the public sector facilities.

As mentioned previously, many women who made an ANC visit within the first three months of their pregnancy went on to have three or more ANC visits during the same pregnancy. These women were considered as having received appropriate ANC services as recommended by the Ministry of Health of Viet Nam. The examination of this combined outcome, results of which are presented in the last two columns of table 3, shows similar differences in appropriate ANC service utilization by individual and community characteristics. The only difference in results is that there was no significant difference in appropriate ANC service utilization between mother age groups. Appropriate ANC was not significantly lower among women aged 30 or more at the time of delivery, compared with women of two lower age groups.

**Table 3. Differences in timing of first ANC visit, number of ANC visits and receiving appropriate ANC during a recent pregnancy, Viet Nam, 2002**

| | First ANC visit within first trimester | | 3 or more ANC visits | | Appropriate ANC | |
|---|---|---|---|---|---|---|
| | Per-centage | Bivariate Odds Ratio (standard error) | Per-centage | Bivariate Odds Ratio (standard error) | Per-centage | Bivariate Odds Ratio (standard error) |
| **Individual-level variable** | | | | | | |
| Household wealth quintile | | | | | | |
| First | 36.3 | 1.00 | 31.4 | 1.00 | 20.8 | 1.00 |
| Second | 50.6 | 1.75 (0.32)** | 53.6 | 2.12 (0.45)*** | 38.6 | 2.02 (0.44)** |
| Third | 63.6 | 3.05 (0.63)*** | 61.7 | 2.82 (0.66)*** | 48.8 | 2.97 (0.69)*** |
| Fourth | 62.8 | 3.10 (0.71)*** | 67.6 | 4.19 (1.10)*** | 54.2 | 4.27 (1.10)*** |
| Fifth | 80.0 | 7.92 (0.273)*** | 81.2 | 8.31 (3.20)*** | 72.7 | 10.21 (3.62)*** |
| Age of respondent at the time of childbirth | | | | | | |
| 15 - 2 | 54.5 | 1.00 | 52.5 | 1.00 | 40.9 | 1.00 |
| 25 - 29 | 54.9 | 0.94 (0.15) | 54.1 | 1.05 (0.18) | 40.3 | 0.92 (0.16) |
| 30 - 49 | 47.3 | 0.59 (0.11)** | 51.7 | 0.67 (0.13)* | 38.8 | 0.66 (0.13) |

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**Table 3** *(Continued)*

| | First ANC visit within first trimester | | 3 or more ANC visits | | Appropriate ANC | |
|---|---|---|---|---|---|---|
| | Per-centage | Bivariate Odds Ratio (standard error) | Per-centage | Bivariate Odds Ratio (standard error) | Per-centage | Bivariate Odds Ratio (standard error) |
| **Ethnicity** | | | | | | |
| Non-Vietnamese | 39.7 | 1.00 | 28.0 | 1.00 | 21.5 | 1.00 |
| Vietnamese | 56.9 | 2.17 (0.46)*** | 60.1 | 3.89 (0.89)*** | 45.8 | 2.79 (0.65)*** |
| **Order of index birth** | | | | | | |
| First to third | 56.3 | 1.00 | 55.6 | 1.00 | 43.1 | 1.00 |
| Fourth or above | 28.0 | 0.28 (0.07)*** | 31.3 | 0.36 (0.09)*** | 18.8 | 0.29 (0.08)*** |
| **Wantedness of index pregnancy** | | | | | | |
| Wanted then | 55.9 | 1.00 | 56.3 | 1.00 | 44.2 | 1.00 |
| Wanted later/no more | 44.7 | 0.64 (0.10)** | 42.9 | 0.58 (0.10)** | 29.1 | 0.53 (0.09)*** |
| **Education** | | | | | | |
| No education | 25.8 | 1.00 | 13.0 | 1.00 | 7.3.0 | 1.00 |
| Primary school | 36.7 | 2.26 (0.65)** | 34.8 | 2.65 (0.88)** | 23.0 | 2.48 (0.96)* |
| Secondary school or higher | 65.1 | 5.88 (1.64)*** | 67.6 | 7.41 (2.39)*** | 53.7 | 7.09 (2.65)*** |
| **Read newspaper once a week** | | | | | | |
| No | 47.2 | 1.00 | 46.7 | 1.00 | 34.0 | 1.00 |
| Yes | 73.6 | 2.60 (0.47)*** | 74.2 | 2.60 (0.53)*** | 62.3 | 2.79 (0.53)*** |
| **Listen to radio everyday** | | | | | | |
| No | 46.8 | 1.00 | 44.1 | 1.00 | 33.9 | 1.00 |
| Yes | 59.1 | 1.43 (0.21)* | 61.3 | 2.03 (0.32)*** | 46.5 | 1.72 (0.27)** |
| **Watch TV at least once a week** | | | | | | |
| No | 35.2 | 1.00 | 33.8 | 1.00 | 23.3 | 1.00 |
| Yes | 57.8 | 2.30 (0.40)*** | 57.9 | 1.96 (0.38)** | 44.8 | 2.06 (0.42)*** |
| Years of residence in community | - | 1.01 (0.01) | - | 1.00 (0.01) | - | 0.99 (0.01) |
| **Community-level variables** | | | | | | |
| Concentration of high SES households in the community | | | | | | |
| Low | 48.6 | 1.00 | 46.3 | 1.00 | 34.0 | 1.00 |
| High | 62.1 | 1.80 (0.33)** | 66.2 | 2.51 (0.61)*** | 53.1 | 2.63 (0.59)*** |
| Concentration of highly educated women in the community | | | | | | |
| Low | 43.6 | 1.00 | 40.6 | 1.00 | 27.6 | 1.00 |
| High | 67.4 | 2.72 (0.47)** | 71.3 | 4.45 (1.03)*** | 59.4 | 4.85 (1.10)*** |

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**Table 3** *(Continued)*

| | First ANC visit within first trimester | | 3 or more ANC visits | | Appropriate ANC | |
|---|---|---|---|---|---|---|
| | Per-centage | Bivariate Odds Ratio (standard error) | Per-centage | Bivariate Odds Ratio (standard error) | Per-centage | Bivariate Odds Ratio (standard error) |
| Telephone services in the community | | | | | | |
| No | 37.9 | 1.00 | 27.1 | 1.00 | 17.7 | 1.00 |
| Yes | 59.1 | 2.36 (0.46)*** | 63.0 | 3.91 (0.96)*** | 49.3 | 3.93 (0.91)*** |
| Type of road to urban centre | | | | | | |
| All weather road | 56.5 | 1.00 | 58.2 | 1.00 | 45.4 | 1.00 |
| Seasonal road | 29.2 | 0.32 (0.10)*** | 14.4 | 0.18 (0.07)*** | 9.1 | 0.21 (0.08)*** |
| Other (river, railway, etc.) | 54.2 | 0.79 (0.18) | 55.8 | 0.59 (0.14)* | 39.7 | 0.55 (0.15)* |
| Private doctor providing ANC services within a 5-km radius | | | | | | |
| No | 52.8 | 1.00 | 53.8 | 1.00 | 41.3 | 1.00 |
| Yes | 54.5 | 0.74 (0.28) | 46.6 | 1.02 (0.28) | 33.7 | 0.61 (0.18) |
| Public-sector health facility providing ANC services within a 5-km radius | | | | | | |
| No | 28.9 | 1.00 | 11.1 | 1.00 | 7.9 | 1.00 |
| Yes | 55.5 | 4.49 (1.26)*** | 57.1 | 10.76 (3.72)*** | 43.6 | 7.92 (3.38)*** |
| **Total** | **53.0** | - | **52.8** | - | **40.3** | - |

*Notes:* [†] p<0.10; * p<0.05; ** p<0.01; *** p<0.001

## Multivariate analyses

### *Timing of first ANC visit*

Table 4 presents the results of the two-level multivariate analyses for the timing and the number of ANC visits, as well as the combined outcome of appropriate ANC service utilization. Overall, for all these outcomes, individual characteristics seemed more important than community and service environment characteristics in their associations with appropriate ANC service utilization.

Many individual characteristics seemed important for both the timing and the number of ANC visits during a recent pregnancy. Women who lived in wealthier households were more likely than women who lived in poorer households to obtain an ANC visit within the first three months of pregnancy or to have at least three ANC

visits. Compared with women in the poorest quintile, women in the richest quintile were 4.1 times more likely to initiate timely ANC and 2.6 times more likely to have three or more ANC visits over the course of their pregnancy (p<0.01 and p<0.05, respectively). Education, another proxy indicator of socio-economic status, was also important: while there was no significant difference between women who had completed primary school and women who had had no schooling, those who had gone to secondary school or higher were more than twice as likely as those who did not go to school to have correctly timed the first ANC visit or to have received the recommended number of ANC visits (OR=2.4, p<0.01 and OR=2.1, p<0.10, respectively). A woman's ethnicity was not related to either outcome of interest.

**Table 4. Associations between individual and community characteristics and appropriate ANC during recent pregnancy, Viet Nam, 2002**

| | First ANC visit within first trimester | 3 or more ANC visits | Appropriate ANC |
|---|---|---|---|
| | Odds Ratio (standard error) | Odds Ratio (standard error) | Odd Ratio (standard error) |
| *Individual-level characteristics* | | | |
| Household wealth quintile | | | |
| First | 1.00 | 1.00 | 1.00 |
| Second | 1.22 (0.25) | 1.14 (0.26) | 1.21 (0.29) |
| Third | 1.85 (0.44)** | 1.30 (0.35) | 1.53 (0.42) |
| Fourth | 1.73 (0.47)* | 1.68 (0.50)$^\dagger$ | 1.99 (0.60)* |
| Fifth | 4.08 (1.59)*** | 2.56 (1.12)* | 4.02 (1.64)** |
| Age of respondent at the time of childbirth | | | |
| 15-24 | 1.00 | 1.00 | 1.00 |
| 25-29 | 0.99 (0.17) | 1.02 (0.19) | 0.94 (0.17) |
| 30-49 | 0.85 (0.17) | 0.86 (0.19) | 0.89 (0.20) |
| Ethnicity | | | |
| Non-Vietnamese | 1.00 | 1.00 | 1.00 |
| Vietnamese | 0.69 (0.16) | 1.41 (0.39) | 0.80 (0.23) |
| Order of index birth | | | |
| First to third | 1.00 | 1.00 | 1.00 |
| Fourth or above | 0.48 (0.13)** | 0.69 (0.20) | 0.54 (0.17)$^\dagger$ |
| Wantedness of index pregnancy | | | |
| Wanted then | 1.00 | 1.00 | 1.00 |
| Wanted later/no more | 0.72 (0.12)* | 0.69 (0.13)* | 0.61 (0.11)** |
| Education | | | |
| No education | 1.00 | 1.00 | 1.00 |
| Primary school | 1.38 (0.45) | 1.19 (0.46) | 1.40 (0.61) |
| Secondary school or higher | 2.44 (0.83)** | 2.10 (0.83)$^\dagger$ | 2.45 (1.08)* |

.../

**Table 4**  *(Continued)*

| | First ANC visit within first trimester | 3 or more ANC visits | Appropriate ANC |
|---|---|---|---|
| | **Odds Ratio (standard error)** | **Odds Ratio (standard error)** | **Odd Ratio (standard error)** |
| Listen to radio everyday | | | |
| No | 1.00 | 1.00 | 1.00 |
| Yes | 0.94 (0.14) | 1.47 (0.24)* | 1.12 (0.19) |
| Watch TV at least once a week | | | |
| No | 1.00 | 1.00 | 1.00 |
| Yes | 1.30 (0.25) | 1.04 (0.22) | 0.99 (0.22) |
| Years of residence in community | 1.01 (0.01) $^\dagger$ | 1.00 (0.01) | 1.00 (0.01) |
| **Community-level characteristics** | | | |
| Concentration of high SES households in the community | | | |
| Low | 1.00 | 1.00 | 1.00 |
| High | 0.86 (0.17) | 0.83 (0.21) | 0.78 (0.18) |
| Concentration of highly educated women in the community | | | |
| Low | 1.00 | 1.00 | 1.00 |
| High | 1.65 (0.29)** | 1.73 (0.40)* | 2.28 (0.52)*** |
| Telephone services in the community | | | |
| No | 1.00 | 1.00 | 1.00 |
| Yes | 1.03 (0.23) | 1.80 (0.50)* | 1.60 (0.44) $^\dagger$ |
| Type of road to urban centre | | | |
| All-weather road | 1.00 | 1.00 | 1.00 |
| Seasonal road | 0.67 (0.21) | 0.78 (0.34) | 0.60 (0.26) |
| Other (river, railway, etc.) | 1.13 (0.25) | 0.99 (0.30) | 0.93 (0.28) |
| Private doctor providing ANC services within a 5-km radius | | | |
| No | 1.00 | 1.00 | 1.00 |
| Yes | 1.44 (0.34) | 0.77 (0.28) | 0.81 (0.27) |
| Public-sector health facility providing ANC services within a 5-km radius | | | |
| No | 1.00 | 1.00 | 1.00 |
| Yes | 1.17 (0.37) | 3.25 (1.43)** | 1.90 (0.89) |
| Log likelihood | -631.4212 | -584.5832 | -574.0474 |
| Community-level ICC | 0.10 (0.08) | 0.57(0.16) | 0.45 (0.15) |
| **N** | **1,042** | **1,042** | **1,042** |

*Notes*:  $^\dagger$ p<0.10; * p<0.05; ** p<0.01; *** p<0.001

Both the timing and the number of ANC visits varied according to the wantedness of the index child. If a child had not been planned, i.e. his birth was either mistimed or unwanted, its mother was significantly less likely to initiate timely ANC. A mother of an unplanned child would be 20 per cent less likely than a mother of a child who was wanted to initiate timely ANC and 30 per cent less likely to have three or more ANC visits during that particular pregnancy (p<0.05 in both cases). Children of higher orders (fourth or above) also tended to be less likely to have received well-timed ANC and the recommended number of ANC visits. If a child was a fourth birth or above, he or she was only half as likely to have had the first ANC visit within the first three months of pregnancy as a child of lower orders (p<0.01). Higher order children (or women who had four or more live births) also seemed less likely than lower order children (or women who had no more than three live births) to have had three or more ANC visits as recommended by the Government, although the difference was not statistically significant. The age of the mother did not have a significant association with either outcome when the number and wantedness of children were controlled for.

Exposure to the media as measured by exposure to newspapers and radio has some association with both outcomes. Compared with women who did not read newspapers every week, those who did were significantly more likely to both initiate timely ANC and receive at least the recommended number of visits during a recent pregnancy: they were 70 per cent more likely to initiate ANC within the first trimester and 65 per cent more likely to receive three or more ANC visits (p<0.01 and p<0.05, respectively). By contrast, listening to the radio did not differentiate between those who initiated timely ANC and those who did not; nevertheless, those who listened to the radio every day were 1.5 times more likely than those who did not to have had three or more ANC visits as recommended (p<0.05). Lastly, watching TV at least once a week was not a significant predictor of either timing of ANC or the number of ANC visits: there were no differences in both outcomes between those who did and those who did not watch television at least every week.

Residence stability, measured by how long a woman had been living in the same community, was a predictor of timing of the first ANC visit, albeit not a strong one, but not of the number of ANC visits. For every year that a woman had been living in the current community, there was a 1 per cent increase in the likelihood that she would initiate ANC in the first three months of a recent pregnancy (p<0.10).

Characteristics at the community level, unlike those at the individual level, were not as strong predictors of timing and number of ANC visits. Among variables that indicate the level of socio-economic development of communities–

the concentration of wealthy households, the concentration of highly educated women in the community and the availability of telephone services only the second variable was a significant predictor of both outcomes. Women who lived in communities where there were many other women who went to secondary school or higher were significantly more likely to have planned the first ANC visit within the first three months (65 per cent more likely) and to have three or more ANC visits (73 per cent more likely) ($p<0.01$ and $p<0.05$, respectively). This relationship is independent of the effects of an individual woman's educational level. The propensity of women to receive ANC within the first trimester or receive at least three ANC visits within a recent pregnancy did not significantly vary according to the average wealth of the community, measured by the concentration of highly wealthy households. The availability of telephone services, another proxy indicator of the economic development of the community, however, was a strong predictor of the number of ANC visits, independent of other community socio-economic variables. Women who lived in communities with telephone services were 1.8 times more likely to have had three or more ANC visits during a recent pregnancy, compared with women who lived in communities with no telephone services ($p<0.05$).

The remoteness of rural communities, measured by the type of roads linking them to the nearest urban centre, was a predictor of neither outcome. The probabilities of receiving ANC within the first three months or receiving three or more ANC visits did not vary between rural communities according to the type of road to the nearest urban centre. The availability of ANC services in the private and public health sectors did little to differentiate between women who initiated and who did not initiate ANC within the first three months of pregnancy, or between women who received three or more ANC visits and those who did not. In addition, neither outcome varied with the availability of private doctors providing ANC services to the community. However, if there was a health facility with ANC services in the public sector, such as a commune or intercommune health centre, women would be three times more likely than women living in communities without ANC services in the public sector to receive three or more ANC visits during a recent pregnancy ($p<0.01$).

The author also examined the associations of service availability in the private and public sectors with both outcomes by an individual woman's household wealth and the level of socio-economic development of the community. None of the results was statistically significant (not shown), indicating no differential variation of the probabilities of good timing and number of ANC visits by service availability between individuals and communities of

different socio-economic statuses. In other words, the availability of ANC services in both public and private sectors did not mitigate the inequalities of ANC service utilization by individual and community socio-economic status.

*Appropriate ANC during a recent pregnancy*

Table 4 (last column) presents results from the multivariate analysis for appropriate ANC during a recent pregnancy. As mentioned before, many women who initiated ANC in the first three months of their pregnancy went on to have at least three ANC visits as recommended. Consequently, it was not surprising that results for appropriate ANC mirror those of timing and number of ANC visits, to a great extent.

Regarding individual characteristics, appropriate ANC was significantly higher among women of the highest wealth quintile and among women who read newspapers at least once a week. Compared with women in the lowest wealth quintile, women in the richest quintile were four times as likely, and women in the fourth (second richest) quintile were twice as likely to receive appropriate timing and number of ANC visits during a recent pregnancy ($p<0.01$ and $p<0.05$, respectively). The wantedness of a child also differentiated women who received from those who did not receive appropriate ANC: the likelihood of receiving appropriate ANC during a pregnancy was 40 per cent lower if a child was not planned, compared with a child who was wanted at that time ($p<0.01$). A child of fourth or above order also had a lower chance (nearly half as likely) of receiving appropriate ANC compared with a child of order three or lower although the difference was only marginally significant ($p<0.10$). The age of the women at the time of delivery did not seem to matter: there were no significant differences in the probability of receiving appropriate ANC between mothers of different age groups.

Education of a woman, while being a significant predictor of both timing and number of ANC visits, lost some of its predicting power in the last, combined analysis. Women who received at least secondary schooling were 2.5 times as likely as women who did not have any schooling to have received appropriate ANC during a recent pregnancy ($p<0.05$). Women who had primary school were not statistically more likely than women without any schooling to have appropriate ANC.

Among variables indicating exposure to mass media, the only differences were found between women who read and women who did not read newspapers once a week: the likelihood of receiving appropriate ANC was two thirds higher among women who read newspapers every week compared with those who did not. Listening to the radio and watching television did not predict whether a woman would

have appropriate ANC during a recent pregnancy. There was also no difference in ANC by the number of years that women had been living in the same community.

Similarly to results for timing and number of ANC visits, most of the community characteristics were not significant predictors of appropriate ANC. Whether a woman had received appropriate ANC during a recent pregnancy did not seem to depend on the availability of ANC services available in the public and private sectors. However, it did vary between communities according to women's education: in communities with a high concentration of highly educated women, pregnant women were more than twice as likely to have received appropriate ANC, compared with women who resided in communities with a low concentration of highly educated women (p<0.001). Women in communities with telephone services were also 60 per cent more likely to have received appropriate ANC during a recent pregnancy, compared with women residing in communities with no telephone services. This difference, however, was only marginally significant (p<0.10).

*Community-level variance*

The second to last row of table 4 presents the ratios between variance at the community-level and total variance that were explained by the models. The ratios represent the relative importance of the individual- and community-level variables in accounting for the variation in the outcomes of interest, or the extent to which the outcomes of interest clustered at the community level. Timing of first ANC visit seemed to be explained mainly by individual-level variables. However, the majority of variations in the frequency of ANC visits were explained by community-level factors, including the socio-economic development of communities and the availability of ANC services in the public sector. Nearly half (45 per cent) of appropriate utilization of ANC services was also explained by community characteristics. This suggests the importance of contextual and service-related factors to women's utilization of health-care services in rural Viet Nam.

## Discussions

Despite seemingly high coverage of antenatal health services and a large proportion of pregnant women who sought care from professional providers at least once during their pregnancy, routine antenatal care among rural women as recommended by the Government of Viet Nam was far from desirable. Just over half of recent pregnancies received ANC during the first three months and a similar proportion of pregnancies received three or more ANC visits. Overall, two in five rural women received appropriate ANC during a recent pregnancy. This leaves 60

per cent of rural women without appropriate ANC service utilization; a small but significant proportion (15 per cent) of rural women did not seek ANC at all during their recent pregnancy.

The study examines the importance of service availability in the community and other community characteristics on women's ANC seeking behaviours. The availability of ANC services at a public sector facility within 5 km of the community was the only service-environment characteristic that had a strong and positive impact on whether rural women received at least three ANC visits during a recent pregnancy. This is consistent with evidence from an earlier study in Viet Nam (Swenson and others, 1993). However, service availability in the public sector was not related either to the timing of first ANC visit or to the probability of appropriate such service utilization (both in terms of timing and number of visits). ANC services in the private sector did not have a significant relationship with either the timing or the number of such visits. By contrast, type of road to access the nearest urban centre did not have any effect on either ANC-seeking behaviours. It could be argued that rural women with easier access to urban areas would be more likely to seek ANC in urban health facilities if such services were not available in rural areas. However, these results suggest that physical access may not be important factors in predicting service utilization. Instead, other dimensions of access and quality of services that were not measured within the DHS may influence individual health service utilization. Bertrand and others (1995) suggest dimensions of access aside from the physical (i.e. administrative, economic, psychosocial and cognitive access) that may influence service utilization decision-making. Nevertheless, the findings highlight the importance of the public sector in catering to health needs of rural women in Viet Nam. The absence of association between private physicians providing ANC services and service utilization may reflect the true role of private health providers. It is also possible that private physicians were not widely available–most of those providing ANC services may be situated more than 5 km away from communities. As a result, the availability of these facilities failed to be significant in the multivariate analyses.

Within the scope of this study, the author did not attempt to examine the quality aspect of ANC services for several reasons. First, no information on the actual or perceived quality of ANC services was collected in the 2002 DHS. Information collected with the Community Questionnaire (e.g. infrastructure, equipment, staff and staff training) only provides an assessment of the preparedness of a facility to provide services. In addition, there is little variation in the preparedness of the public sector health facilities that were included in the

sample most of them commune health centres in rural areas, where the Government of Viet Nam has implemented strategies with a view to improving health-service access and quality at these first contact points. Finally, in the 2002 DHS, information on health facilities was available only for those in the public sector. No private sector facilities were visited. Inclusion of variables related to the preparedness (or readiness) of public health facilities without equivalent information on the private sector might introduce information biases and lead to imprecise estimates of the effects of services in both sectors on service utilization.

Findings of the study indicate associations of individual and community socio-economic characteristics with ANC seeking behaviours. These associations exist independently of service environment characteristics. Women of higher individual socio-economic status (as measured by household wealth and education) as well as those women living in communities with more highly educated women, were significantly more likely to utilize ANC services within a recent pregnancy. Results suggest a significant level of inequality in ANC service utilization between rural women of different socio-economic statuses. The associations between household wealth, education and service utilization were not found to vary by service availability in the present study. It is possible that with the primary health-care system that the Government has developed since the 1950s, maternal health care, including ANC, has been prioritized and thus made available widely. Service availability in the public sector, therefore, is not likely to be more important for the poor than for the rich. Meanwhile, ANC services in the private sector in rural Viet Nam are yet to be made available on a large scale. As a result, inequalities in ANC service utilization are likely to be a result of factors other than unequal physical access to services. Unfortunately, other dimensions of access to services, as mentioned above, are not measured in this study. It is also possible that women of higher socio-economic status are more knowledgeable with regard to maternal health care, and thus are more likely to seek care.

Individual demographic characteristics, such as order and wantedness of the index birth, were found to have significant associations with ANC-seeking behaviours. For fourth- or higher-order births, the propensity of having ANC visits within the first trimester as well as appropriate ANC service utilization were significantly reduced. One explanation for this is that women who were older and/or of higher parity may be more likely to go through their pregnancies based upon past experiences, and therefore to be less likely to seek antenatal care. There was also some evidence of lower likelihood of antenatal care for pregnancies that were reported as mistimed or unwanted. However, it is important to keep in mind that wantedness of pregnancies in the three years preceding the survey was asked at

the time of the survey and women might have adjusted their response after they had given birth. As a result, the findings may underestimate the effects of wantedness of pregnancies on ANC-seeking behaviours.

The study shares a number of limitations with other studies that use DHS data to examine effects of service environment on health-related behaviours. As mentioned above, only physical access and availability of ANC services were measured. Other dimensions of access which were not measured may in fact be more important than physical access for ANC service utilization. Service utilization is also a function of both access and (perceived and/or actual) quality of services; nonetheless quality of ANC services was not measured, neither in the public sector nor in the private sector. In addition, service availability was measured at the time of the survey and was assumed to have remained unchanged during the three years preceding the survey. Another assumption is that women would seek ANC services from within the communities that they resided in. This assumption may not hold in reality, as some women may be willing to travel beyond their community limits to seek services that may be perceived of higher quality. This assumption was tested to a certain extent by the variable that indicates access to a nearest centre, which did not have significant associations with ANC-seeking behaviours. It may suggest that physical access is not of primary importance for ANC service utilization. Similarly to service availability, other important individual characteristics, such as wantedness of pregnancies, were also measured at the time of the survey and thus may be subject to measurement errors.

Finally, cautions should be exercised in the interpretation of the associations of service availability at government and private sector facilities with service utilization. Services may not be randomly situated and the findings may be biased as a result. Private physicians are more likely to be located in areas where there is higher demand for services, resulting in an overestimation of the effects (if any) of ANC service availability in the private sector. Meanwhile, government facilities that offer ANC services may be located in areas with low or high demand for services. If they are situated in areas with low demand for ANC services, the effects of service availability on utilization may be underestimated. By contrast, if government health centres offering ANC services are located in areas where demand is high, failure to take the targeted allocation into account would result in overestimating the effects of service availability.

Notwithstanding the limitations of data in measuring access and quality of ANC services, the findings of this study still reveal gaps in ANC service utilization among rural women despite seemingly high service coverage. This article

highlights the role of public sector facilities that offer ANC services in increasing ANC service utilization among rural women in Viet Nam. The Government should pursue its efforts to improve the availability of ANC services at existing and/or new health facilities in rural areas, particularly those that are remote and largely occupied by ethnic groups. Any interventions that aim to increase maternal-health-service utilization should include efforts to target rural women of lower health status and educational achievements, as well as areas where women in general do not have high educational achievements.

The findings also suggest that other factors, aside from service availability, may drive service utilization differentials between wealth quintiles among rural women. These factors may include disparities in economic and cognitive access, perceived quality of ANC services, and differences in individual knowledge and attitudes towards ANC services. A comprehensive conceptual framework of how different dimensions of access to and quality of health services may effect service utilization in Viet Nam needs to be developed and tested. Such a framework should also take into account the emergence of non-public sectors that are increasingly involved in the provision of health services. A more comprehensive understanding of the service environment, consisting of all sectors and how different dimensions of service provision may effect utilization, will guide efforts to improve service utilization.

# References

Bertrand, J.T. and others (1995). "Access, quality of care and medical barriers in family planning program", *International Family Planning Perspectives,* vol. 21*, No. 2, pp. 64-69 and 74.

Bollen, K.A., J. Glanville and G. Stecklov (2001). "Socioeconomic status and class in studies of fertility and health in developing countries", *Annual Review of Sociology,* vol.. 27, pp.153-185.

Bruce, J. (1990). "Fundamental elements of quality of care: a simple framework", *Studies in Family Planning,* vol. 21, No. 2, pp. 61-91.

Celik, Y. and D.R. Hotchkiss (2000) "The socio-economic determinants of maternal health care utilization in Turkey", *Social Science and Medicine*, vol. 50, No. 12, pp. 1797-1806.

Filmer, D. and L. Pritchett (2001). "Estimating wealth effects without expenditure data – or tears: an application to educational enrollments in states of India", *Demography*, vol. 38, No. 1, pp. 115-132.

Glei, D., N. Goldman and G. Rodríguez (2003). "Utilization of care during pregnancy in rural Guatemala: does obstetrical need matter?", *Social Science and Medicine,* vol. 57, No. 12, pp. 2447-2463.

Goldstein, Harvey (1995). *Multilevel Statistical Models* (London: Edward Arnold).

Greenland, S. (1992). "Divergent biases in ecologic and individual-level studies", *Statistics in Medicine,* vol. 11, No. 9, pp. 1209-1223.

_____ (2001). "Ecologic versus individual-level sources of bias in ecologic estimates of contextual health effects", *International Journal of Epidemiology,* vol. 30, No. 6, pp. 1343-1350.

Griffiths, P. and R. Stephenson (2001). "Understanding users' perspectives of barriers to maternal health-care use in Maharashtra, India", *Journal of Biosocial Sciences,* vol. 33, No. 3, pp. 339-359.

Magadi, M.A., N.J. Madise and R.N. Rodrigues (2000). "Frequency and timing of antenatal care in Kenya: explaining the variations between women of different communities", *Social Science and Medicine,* vol. 51, No. 4, pp. 551-561.

Pebley, A.R., N. Goldman and G. Rodríguez (1996). "Prenatal and delivery care and childhood immunization in Guatemala: do family and community matter?", *Demography,* vol. 33, No. 2, pp. 231-247.

Rutstein, S.O. and K. Johnson (2004). "The DHS Wealth Index", *DHS Comparative Reports,* No. 6 (Calverton, Maryland, United States of America, ORC Macro).

Shieh, Y.Y. and R.T. Fouladi (2003). "The effect of multicollinearity on multilevel modeling parameter estimates and standard errors", *Educational and Psychological Measurement,* vol. 63, No. 6, pp. 951-985.

StataCorp (2005). *Stata Statistical Software: Release 9* (College Station, Texas, United States of America, StataCorp).

Stephenson, Rob and Amy O. Tsui (2002). "Contextual influences on reproductive health service use in Uttar Pradesh, India", *Studies in Family Planning,* vol. 33, No. 4, pp. 309-320.

Swenson, I.E. and others (1993). "Factors related to the utilization of prenatal care in Vietnam", *Journal of Tropical Medicine and Hygiene,* vol. 96, No. 2, pp. 76-85.

Tran, T. and others (2005). "Comparative quality of private and public health services in rural Vietnam", *Health Policy and Planning,* vol. 20, No. 5, pp. 319-327.

Valdivia, Martín (2002). "Public health infrastructure and equity in the utilization of outpatient health care services in Peru", *Health Policy and Planning,* vol. 17, Suppl. No. 1, pp. 12-19.

Viet Nam (1995). *Vietnam Intercensal Demographic Survey 1994: Major Findings,* General Statistical Office (GSO) (Hanoi, Statistical Publishing House).

_____ (1999). *Vietnam Demographic and Health Survey 1997* (Hanoi, National Committee for Population and Family Planning).

_____ (2001). *National Strategy on Reproductive Health Care for the 2001-2010 Period* (Hanoi, Ministry of Health.

_____ and ORC Macro (2003). *Vietnam Demographic and Health Survey 2002.* (Calverton, Maryland, United States of America Committee for Population, Family and Children (CPFC)[Viet Nam]).

Wakefield, J. and R. Salway (2001). "A statistical framework for ecological and aggregate studies", *Journal of the Royal Statistical Society,* vol. 164, No. 1, pp. 119-137.

Wagstaff, A. and N. Watanabe (2003). "What difference does the choice of SES make in health inequality measurement?", *Health Economics,* vol.12, No. 10, pp. 885-890.