The Relationship between Prenatal Care and Subsequent Modern Contraceptive use in Bolivia, Egypt and Thailand

Assata Zerai[1] *and Amy Ong Tsui*[2]

ABSTRACT

Determinants of modern contraceptive use are usually examined in isolation of the effect of exposure to other aspects of health care systems. Maternal interaction with organised health service provision during post-conception and postpartum stages of reproduction can provide an opportunity to transfer contraceptive service information and counselling. We found that living in a community in which women have widespread health service contact is related to both prenatal care use and subsequent modern contraceptive use. After controlling for effects of living in high health service contact areas and various demographic and background factors, our results suggest that prior use of prenatal care has a strong influence on subsequent use of modern contraception in Bolivia, Egypt and Thailand. (*Afr J Reprod Health* 2001; 5[2]:68-82)

RÉSUMÉ

Rapports entre les soins prénatals et l'utisisation par la suite de la contraceptive moderne en Bolivie, en Egypte et en Thaïlande. Les déterminants de l'utilisation moderne de la contraceptive sont examinés en genéral de manière isolée par rapport à l'effet de l'exposition aux aspects des systèmes de services médicaux. L'interaction avec l'assurance des services médicaux organisés pendant les stades post-conception et post-partum de la reproduction peut fournir une occasion pour le transfert de l'information et la consultation sur le service de contraception. Nous trouvons que le fait de vivre dans une communauté dans laquelle les femmes ont de contact avec des services médicaux bien répandus est lié à la fois à l'utilisation des soins prenatals et par la suite à l'utilisation de la contraceptive. Ayant contrôlé pour déterminer les conséquences d'habiter dans les régions de contact des services médicaux et des facteurs démographiques et des milieux divers, nos résultats font penser que l'utilisation préalable des soins prénatals a une grande influence sur l'utilisation éventuelle de la contraception moderne en Bolivie, en Egypte et en Thailande. (*Rev Afr Santé Reprod* 2001; 5[2]:68-82)

KEY WORDS: *Prenatal care, modern contraceptive use, Bolivia, Egypt, Thailand*

[1]*Syracuse University.* [2]*University of North Carolina at Chapel Hill.*

Correspondence: *Assata Zerai, Sociology Department, 302 Maxwell Hall, Syracuse University, Syracuse NY 13244.*

Introduction

Determinants of modern contraceptive use are usually examined in isolation of the effect of prior exposure to other aspects of health care systems. In this study we are interested in the effect of a woman's prenatal care on the likelihood of her subsequent use of modern contraception. We hypothesise that early exposure to pregnancy-related services can increase a woman's propensity to use modern contraceptives after the birth of her child for a number of reasons we will discuss. The prenatal care-contraceptive use relationship is examined at two periods in the woman's life – prior and subsequent to the delivery of the last child and the second to the last child. The sequence of relationships of interest is for the two birth intervals. For the latest birth (index child i), we test whether the mother's exposure to formal prenatal care for child i influences her use of modern contraception after birth. For a subset of these women with two births in the recent past, we examine the same relationship of the effect of prenatal care for child i-1 on the mother's use of modern contraceptives, following child i-1's birth (see Figure 1).

The relationship is tested using Demographic and Health Survey (DHS) data from Bolivia, Egypt and Thailand.[1,2,3] The criteria for selection are several. Apart from the need to locate appropriate and comparable cross-national data, all three countries have maternal and child health and family planning (MCH/FP) programs that are structurally integrated to some degree, either centrally or at community service levels. The countries also vary along cultural, population and health policy, as well as social development dimensions. The three societies reflect distinctive cultural influences of various geopolitical regions of the world.

Variation between the countries on population, health and social development dimensions is evident from Table 1. Bolivia, Egypt and Thailand do not uniformly occupy extreme positions on the economic development continua. Bolivia and Egypt are on the lower end of the economic development continuum, both having low per capita gross national product of $620 and $600 respectively.[4] Thailand is at the higher end of the economic development scale, its per capita GNP is $1420.

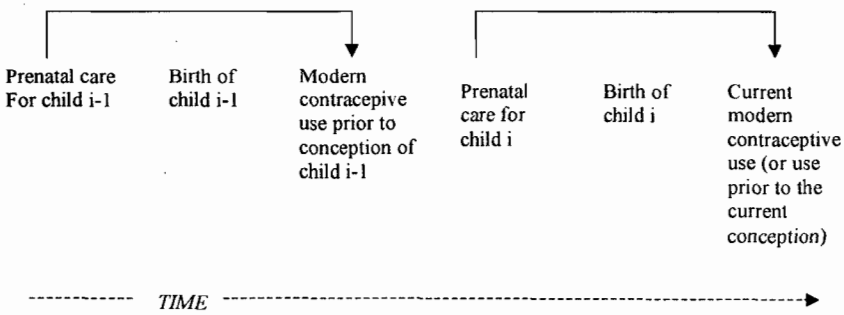

Figure 1 **Main Relationships of Interest**

Table 1 **Summary Information for Married Women Giving Birth in the Last Five Years in Bolivia, Egypt and Thailand**

Country	DHS survey year	Residents giving birth in last 5 years	Children born in last 5 years	1992 GNP per capita (US$)	Percent using modern contraceptives	Infant mortality rate	Under-5 mortality rate	Total fertility rate	Care	Mother's educational level			
										None	Primary	Secondary	Tertiary
Bolivia	1989	3188	5179	620	12	88	131	5	47	18	36	16	31
Egypt	1989	5104	8359	600	36	73	102	5	53	51	23	10	16
Thailand	1987	2630	3376	1420	64	36	45	2	78	10	79	8	4

Sources: 1. Respective DHS country reports for Bolivia, Egypt and Thailand. 2. Analysis of DHS Bolivia, Egypt and Thailand data. 3. Comparative Studies 2: Fertility, DHS Newsletter (1991). 4. Population Reference Bureau 1992 World Population Data Sheet.

GNP per capita does not give any indication of income distribution, but infant and early childhood mortality rates may give a better, if more crude, indication of how equally distributed economic resources are within a population. UNICEF has suggested using under-five mortality to measure development rather than per capita GNP. If we compare the three countries, listing them from the highest to the lowest infant and child mortality rates, Bolivia is the poorest and has the worst distribution of resources, as indicated by its high infant (88 per 1,000 live births) and child (131 per 1,000 live births) mortality rates in the last five years preceding the survey (1984–1989). Egypt's per capita GNP is similar to Bolivia's and its infant mortality rate is also high at 73 per 1,000 live births, with under-five mortality at 102. Thailand and Bolivia both have a child mortality rate (45 per 1,000 live births respectively) lower than Egypt's. Thailand's distribution of socio-economic resources may be more favourable for child health.

Prenatal Care and Family Planning

Prenatal care coverage varies substantially across all three countries. In Thailand, most women report receiving some prenatal care (78%), compared to Bolivia where less than half of pregnant women receive such care (47%). Only a few more women use prenatal care in Egypt (53%) than in Bolivia.

Prenatal care and modern contraceptive prevalence are not well correlated among the three countries. The lowest prevalence level among these three countries is found in Bolivia (12%). The highest modern contraceptive use level is Thailand's (64%), which has the second highest prenatal care coverage. Although one half of married Egyptian women have received prenatal care, just slightly more than one third are currently using modern contraceptives.

Prenatal care is expected to influence subsequent modern contraceptive use positively for several reasons. First, where family planning services are available, they tend to be delivered within the context of maternal and child health services. Pregnancy-related services have traditionally emphasised antenatal, along with delivery and postnatal care. Pre- or post-conceptional contact by women with the formal health system is likely to expose them to various types of reproductive and child health care information and services. We suspect that a woman's early contact with this system may be beneficial for her later practice of contraception. Prenatal service use may increase the probability of women's post-delivery care, either for their infants or themselves.[5] Service protocols for established pregnancies recommend postpartum introduction of contraceptive information, along with pre-conceptional promotion.[6] The rising risk of sexually transmitted diseases, for which pregnant women should theoretically be screened during prenatal visits, has furthered the integration of MCH and contraceptive services with sexually transmitted disease prevention and treatment services. As a result, MCH service by trained health providers is likely to link system clients to various types of reproductive care.[7] Analysis by Becker et al[8] of the utilisation of different MCH services finds common determinants in several client characteristics (e.g., maternal education and socioeconomic status), suggesting that both forces of self-motivation for repeated use and awareness of multiple services are in operation.

The content of prenatal care may or may not directly include any contraceptive counselling, and the data at hand do not allow us to know this. Contraceptive information and counselling is not a major thrust of prenatal interventions, since these are generally oriented towards preventing maternal morbidity and mortality and improving perinatal outcomes.[9,10] However, a second reason for expecting a close relationship is that targeted prenatal care interventions tend to focus on women with high-risk conditions (very young, very old, short birth intervals and high parity) and may be followed up by contraceptive promotion and services to reduce subsequent pregnancy and health risk.[11]

Thirdly, a further plausible causal though indirect connection between prenatal care and contraceptive behaviour is the potential and intended impact of prenatal care on the probability of infant and child survival. Reduced child loss can reduce fertility demand, motivating mothers to seek or be amenable to presented means for birth control from the formal health system.

Finally, we would note that the absence of a complete history of contraceptive practice and prenatal care precludes a full understanding of the direction of causalty between these two behaviours. It is possible that in a woman's reproductive

history contraceptive use may precede antenatal care, thereby introducing the woman to the health care system and influencing her use of pregnancy-related services, as Jamieson and Buescher[12] have shown in a US study. We have included contraceptive use prior to the index conception as an additional determinant in each model, but this may only capture actual initial practice for women of 0–2 parity. From a policy perspective, what we hope to observe in this analysis is a strong causal connection between these two behaviours that is facilitated by formal health service delivery. This would suggest women's access to adequate reproductive care (both prenatal and family planning services) to be mutually reinforcing of their use of key preventive services and influential of improved health outcomes.

Maternal, Child Health and Family Planning Programs in the three Countries

Background information on maternal and child health and family planning (MCH/FP) programs in the three countries may further help us understand the expression of the prenatal care-modern contraceptive use relationship within each.

Bolivia, with a current population of 8.2 million, has long been noted for its pronatalist population policy and lack of public support for contraceptive service delivery. Its maternal and child health program strategy, articulated in its 1989 National Plan for Child Survival and Development and Maternal Health, promotes services for reproductive health, prenatal care, delivery assistance, postpartum care, and breastfeeding.[13] In this sense we would expect to see less influence from prenatal care through the formal health system on modern contraceptive use than in other countries, largely due to the constrained availability of public services for the latter.

The main objective of Egypt's national health policies in the 1960s and 1970s was to increase service coverage for the country's population. Significant growth in the number of health units, hospitals, paramedic staff and physicians occurred, although the ratio of population to provider or facility continued to increase. Egypt, with a population of 51 million, also pursued a primary health care strategy emphasising child survival, diarrheal disease control, and strengthening of rural health services. The family planning program is coordinated through the National Population Council established in 1984, as a successor to the National Family Planning Board. Integration between MCH and FP occurs primarily at the service level, in the network of over 4,000 government-operated facilities, including hospitals, MCH centres and family planning clinics.[2]

Thailand, with a population size of 59 million persons, similar to Egypt's, has also strongly promoted MCH and family planning service access and care, particularly in rural areas. Almost 29,000 health facilities deliver MCH and family planning services throughout the country. Village surveillance systems are in place to refer pregnant women for family planning counselling.[14] The Thai family planning program, established in 1970 within the Ministry of Health, has operated fairly independently of the MCH program, at least at the central level. Coverage of maternal health services (prenatal care, tetanus toxoid immunisation, delivery assistance by trained personnel and at a health facility) – between 60 and 77% of children – is among the highest in developing countries. Socioeconomic differentials in the utilisation of maternal and child health services exist.[15] Contraceptive prevalence has risen quickly in the country over the past two decades. Knodel and Chayovan[16] found a growing trend in the initiation of contraceptive use among married Thai couples prior to the begining of childbearing. They note as well that contraception is rapidly adopted postpartum, evidencing a spreading pattern of contraceptive use for spacing as well as limiting births.

Theoretical Model

We believe that background, demographic, and aggregate community and household variables work through prenatal care use to indirectly affect subsequent modern contraceptive use. We also believe background, demographic and aggregate characteristics and fertility demand exert a direct effect on current modern contraceptive use (see Figure 2).

We cannot simply estimate the direct effects of demographic, background, motivational, aggregate and prenatal care variables on contraceptive use because prenatal care is endogenous in this theoretical structure. The true magnitude of prenatal care's effect on modern contraceptive use cannot

be measured properly unless we take account of the fact that demographic, background and aggregate variables affect modern contraceptive use indirectly through their effects on prenatal care use. Thus, we employ an analytic strategy that enables us to account for direct and indirect effects of our independent variables.

Since both dependent variables are dichotomous, we use the bivariate probit model to estimate these two equations simultaneously. Even though the probit model is non-linear, we write the model in linear form for expositional purposes:

$$PNC_i = \beta N_1 x_{1i} + \varepsilon_{1i} \quad (1)$$

$$FP_i = \alpha N_1 PNC_{1i} + \alpha N_2 z_{2i} + \varepsilon_{2i} \quad (2)$$

Where:

PNC_i = Dichotomous variable indicating prenatal care use for woman i

FP_i = Dichotomous variable indicating modern contraceptive use for woman i

$\beta N_1 x_{1i}$ = Set of β coefficients multiplied by the vector (x_i) of prenatal care determinants

εN_{1i} = Error term associated with equation (1)

$\alpha N_1 PNC_{1i}$ = Coefficient α_1 multiplied by the prenatal care variable

$\alpha N_2 z_{2i}$ = Set of coefficients α_2 multiplied by the vector (z_i) of other modern contraceptive use determinants

ε_{2i} = Error term associated with equation (2)

The use of prenatal care (PNC_i) by woman i is a function of the set of coefficients multiplied by the vector of prenatal care determinants (x_i) plus the error term (ε_{1i}) for this equation. Further, the use of modern contraceptives (FP_i) by woman i is a function of the coefficient α_1 multiplied by the prenatal care variable (PNC_i) plus the set of coefficients α_2 multiplied by the vector of other modern contraceptive use determinants (z_i) and the error term (ε_{21}) associated with the modern contraceptive use equation. The error terms are assumed to follow a bivariate normal distribution, which leads to the probit specification.

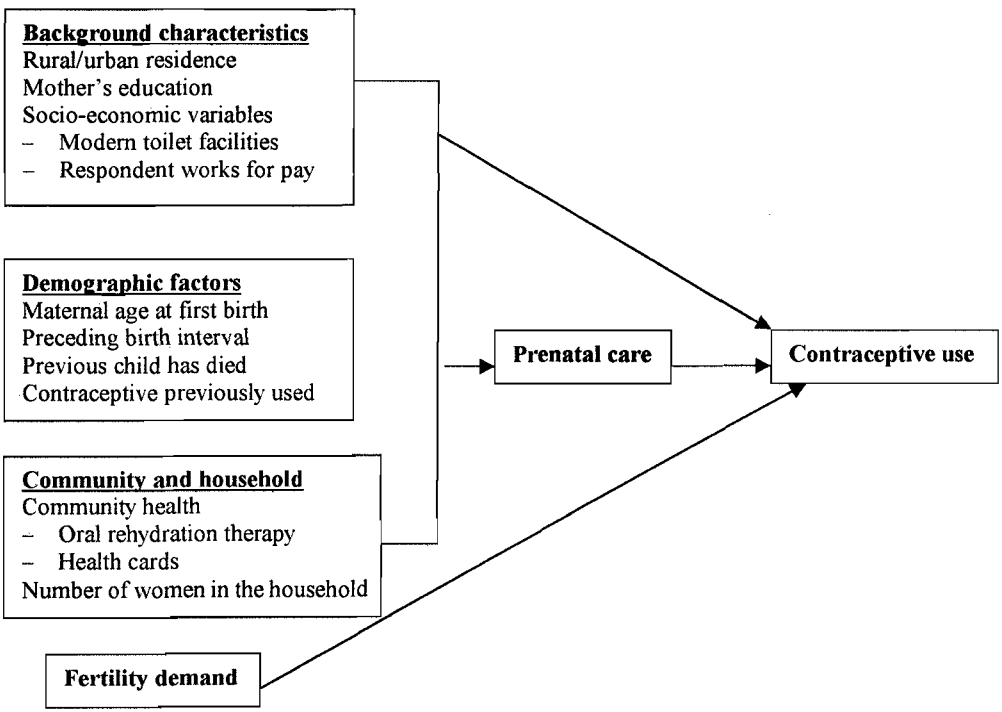

Figure 2 **Determinants of Prenatal Care and Modern Contraceptive Use: Conceptual Model**

The two equations are estimated simultaneously with prenatal care specified as an endogenous variable.[a] This reduces the possibility of obtaining biased estimates of prenatal care's effects on contraceptive use. In a single equation model, prenatal care's effect may be overestimated if similar factors influence motivation for prenatal care as well as contraceptive use. We use the bivariate probit to perform this estimation because it makes the standard assumption of normally distributed standard error terms that is traditional for continuous dependent variables. Also there is no theoretical justification for using the logit function in this instance. It is desirable that x_i and z_i do not overlap completely, i.e., the set of determinants for PNC_i may not be identical to those for FP_i for the model to be identified. However, in our case considerable overlap is present, with the exception of the fertility demand variable that only has an effect on FP_i. This lack of exclusion restrictions does not present an identification problem, since the bivariate probit estimation method is inherently nonlinear.[18] Of course, valid exclusion restrictions would be useful and would probably increase the stability of the estimated coefficients. Unfortunately, such restrictions are not available in the DHS data sets. Finally, because the two dependent variables are dichotomous, we must use maximum likelihood estimation procedures.

We also estimate the ρ (rho) statistic, which represents the correlation in the error terms of the two equations. Significantly related error terms suggest an overlap in unobservable variables affecting both equations (1) and (2), i.e., that prenatal care is endogenous in this theoretical structure and estimation methods that do not take this into account would give misleading results. Statistically significant ρ values would empirically justify our hypothesis and choice to solve the equations simultaneously.

The independent variables associated with prenatal care use and modern contraception are detailed below:

$$PNC_i = (MOMAGE_i, PRECBI_i, DIED_i, PREVFP_i, RESID_i, MOMEDUC_i, TOILET_i, PAIDWORK_i, COMORT_i, COMHCARD_i, HHWOMEN_i)$$

$$FP_i = (MOMAGE_i, PRECBI_i, DIED_i, PREVFP_i, RESID_i, MOMEDUC_i, TOILET_i, PAIDWORK_i, COMORT_i, COMHCARD_i, HHWOMEN_i, MOREKIDS_i, PNC_i)$$

The variable operationalisations are given in Table 2. Prenatal care is measured specific to the index pregnancy (i or i-1). Contraceptive use is measured subsequent to the birth of the index child; however, for child i-1, it relates to any, rather than the first, use of modern contraception prior to the conception of child i. Multiple episodes of use in this closed interval are recorded in the DHS. Contraceptive use subsequent to child I's birth is measured as current use at the time of the survey. Other episodes of use that may occur after the last child's birth are again not fully known in the DHS. If the mother is pregnant at the time of the survey, her use of contraception prior to conception is measured and she is included in the current use model.

The demographic variables in the prenatal care and contraceptive use models are maternal age at the birth of her first child, sufficient lengths of preceding birth interval, whether or not a previously born child has died, and whether modern contraceptives have been previously used.[b] The expected causality is described below.

As noted earlier, we expect that women at greater risk of problem births will be targeted by

[a] *While a reduced form specification can be made, in this case FPi = aN1bNx1i + aN2z2i + (e1i + e2i), which is the substitution of equation (1) into equation (2); it is not a preferred analytic approach. The reduced form model does not allow one to understand the causal pathways in particular for policy-relevant variables such as prenatal care. It can also lead to inappropriate policy decisions if opposite influences exist in a structural model but are undetected through a reduced form.*[17]

[b] *These demographic factors are often considered to be endogenous in microeconomic models of contraceptive behaviour. That is, maternal age at first birth, preceding birth interval length, and prior infant loss are seen as largely determined by exogenous variables, primarily those used here as background characteristics. Because of the narrow window of effect, i.e., the birth interval, we choose to focus on these as exogenous "risk" conditions. They are used for risk ascertainment by health program personnel in community surveillance*[23] *and as personal factors influencing mothers' decision to contracept following her child's birth.*

the health system in their respective countries for prenatal care. These include women who are at older and younger extremes of their childbearing years, women with short preceding birth intervals, and women who have already experienced the death of a child. Women who have previously experienced the death of an infant or child have an additional motivation to seek out prenatal care to insure the health of their fetus.

The background characteristics in both models are rural/urban residence, mother's educational level, and finally other socio-economic variables, including whether or not the mother's household has flush toilets, and whether or not she works for pay. Urban residence is expected to influence prenatal care use positively because this environment offers greater access and exposure to such services.[19] Women with more education are expected to use prenatal care services to a greater extent than women with less education, as the former tends to have more autonomy in health decision-making.[8,17,20-22] Modern household toilet facilities and women working for pay are proxies for socio-economic status. Overall, we expect that the better the woman's status, the more likely she is to receive prenatal care.

Determinants of prenatal care also include variables aggregated at the household and community levels. The presence of other women of childbearing age in the household measures the potential sharing of prenatal care knowledge and support for its use. Two measures of health contact at the community level are expected to influence individual prenatal care use — the proportion of women in the community who have knowledge of oral rehydration therapy and the proportion of women in the community who have health cards for children on which health professionals record immunisations. These are obtained by aggregating data across respondents from the same sample cluster, a means of approximating communities of residence. We expect that women living in communities with high degree of contact with health services, as indicated by widespread knowledge of oral rehydration therapy and possession of health cards, are more likely to utilise prenatal care services relative to women living in communities with less contact.

A fertility motivation variable is added to the vector of contraceptive use determinants: woman's desire for more children at the time of the survey. The actual parity and reported ideal number of children are compared, to derive a variable that measures the motivation to contracept. Finally, whether or not the woman used prenatal care before the birth of the last child is included in the modern contraceptive use model.

Data and Descriptive Results

Demographic and Health Survey data for the three countries provide appropriate measures for studying the relationship between prenatal care use and subsequent practice of modern contraception. Women of childbearing age in Bolivia, Egypt and Thailand were interviewed between 1987 and 1989 using a standard questionnaire. The sample sizes for the three countries range from about 4500 to 9000 women. For this analysis, we have selected a sample of married women who gave birth in the last five years. Here, the sample sizes range from 2630 to 5104 across the three countries.

Descriptive statistics for dependent and independent variables in the three countries are presented in Table 3.[c] Prenatal care use before the birth of the last child and prior to birth of the second to the last child is listed first, followed by modern contraceptive use currently and prior to the birth of the last child.[d] The means for women in this sample using prenatal care and modern contraceptives are compatible with the descriptive statistics based on overall samples in Table 1. The variation across the distributions seen in Table 2 emphasises the differential character of each of the three countries and the likely variable expression of the prenatal care-modern contraceptive use relationship within each.

Multivariate Results

Table 4 gives the bivariate probit results. The top panel reports the direct effects of independent

[c] *Summary statistics in Table 3 are those for the current use model, descriptive statistics for the next to last birth model are available from the authors.*

[d] *Traditional contraceptive use and non-use of contraception is contrasted with modern contraceptive use.*

variables on contraceptive use while the bottom panel shows the results on the direct effect of independent variables on prenatal care. We will briefly review the results to identify the variables that were consistently significant across the three countries, and summarise the results by country and highlight the most outstanding ones across countries.

Table 2 **Independent Variables used in the Analysis**

Variable	Definition and categories	Range of values
Dependent variables		
Prenatal care	Prenatal care by trained health provider for child i and child i-1	(0,1)
Family planning	Use of modern contraception after birth of child i and child i-1	(0,1)
Demographic variables		
Mother's age	Mother's age at the birth of her first child measured as:	
	Under 19 years	(0,1)
	19 to 23 years = reference over 23 years	(0,1)
Preceding birth interval length	Preceding birth interval is greater than 24 months	(0,1)
Previous child died	Previous child has died	(0,1)
Previously used modern contraception	Use of modern contraceptives prior to child's birth	(0,1)
Background variables		
Rural/urban residence	Urban residence	(0,1)
Mother's education	Mother's level of education measured as:	
	Incomplete primary	(0,1)
	Complete primary = reference secondary or higher	(0,1)
Household has a toilet	Mother's household has modern toilet facilities	(0,1)
Mother works for pay	Mother works for pay	(0,1)
Aggregate variables		
Oral rehydration therapy in the community	Percentage of women in the community (cluster) with knowledge of oral rehydration therapy	(0,100)
Health card use in the community	Percentage of women in the community with health cards for their children	(0,100)
Number of women in the household	Presence of other women of childbearing age in the household	(0,9)
Motivational variables		
Ideal family size	Difference between desired and ideal number of children measured as:	
	Desires no more	(0,1)
	Desires one more = reference	(0,1)
	Desires two or more	(0,1)

Note: In the prenatal care equation, mother's education is dichotomised into incomplete primary education (1) or complete primary or higher (0).

Variables with Direct Effect on Modern Contraception

The results provide empirical support for our hypothesis: prenatal care has a strong positive and significant effect in Bolivia, Egypt and Thailand. The magnitude of its effect on subsequent modern contraceptive use is greatest in Bolivia (coefficient is 1.462, $p < 0.001$), followed by Egypt (1.1394, $p < 0.001$) and Thailand (0.9959, $p < 0.01$). Other independent variables that consistently and directly affect current modern contraceptive use include maternal education, fertility motivation and previous use of contraception.

Table 3 **Descriptive Statistics on Women Giving Birth in the Last Five Years in Bolivia, Egypt and Thailand**

Variable	Bolivia			Egypt			Thailand		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
DEPENDENT VARIABLES									
1. PNC use – last child born	0.64	0.48	2944	0.62	0.49	4955	0.86	0.35	2626
2. PNC use – 2nd to last child born	0.50	0.50	1477	0.52	0.50	2517	0.78	0.41	666
3. Current modern contraceptive use	0.13	0.34	2950	0.39	0.49	4963	0.66	0.47	2630
4. Modern contraceptive use prior to birth of the last child	0.07	0.25	2950	0.35	0.48	4963	0.49	0.50	2630
INDEPENDENT VARIABLES									
Demographic variables									
Age of mother at 1st birth									
5. Mother under age	190.42	0.49	2950	0.45	0.50	4963	0.53	0.50	2630
6. (Mother aged 19 to 23 years)	0.44	0.50	2950	0.44	0.50	4963	0.41	0.49	2630
7. Mother over age	230.14	0.34	2950	0.11	0.31	4963	0.06	0.23	2630
Experience with child mortality									
8. Previous child has died	0.32	0.47	2950	0.33	0.47	4963	0.10	0.30	2630
Sufficient spacing of births									
9. Preceding interval > 24 months	0.76	0.43	2925	0.73	0.44	4961	0.84	0.37	2621
Modern contraceptive use									
10. Modern contraceptive use prior to birth of 2nd to the last child	0.02	0.13	2950	0.10	0.30	4963	0.08	0.28	2630
Background variables									
11. Rural/urban residence	0.56	0.50	2950	0.45	0.50	4963	0.34	0.47	2630
Mother's education									
12. Incomplete primary level	0.19	0.39	2950	0.50	0.50	4963	0.07	0.26	2630
13. (Complete primary level)	0.46	0.50	2950	0.31	0.47	4963	0.74	0.44	2630
14. Secondary or higher	0.35	0.48	2950	0.19	0.39	4963	0.19	0.39	2630
Socio-economic variables									
15. Modern toilet facilities	0.28	0.45	2950	0.21	0.41	4963	0.04	0.18	2630
16. Mother works for pay	0.19	0.40	2950	0.12	0.32	4961	0.56	0.50	2629
Aggregate variables									
17. Additional women in the household	0.22	0.42	2950	0.22	0.41	4963	0.16	0.36	2630
18. Knowledge of oral rehydration therapy	0.75	0.25	2950	0.98	0.04	4963	0.86	0.12	2630
19. Use of health cards	0.77	0.23	2950	0.96	0.07	4963	0.54	0.26	2630
Motivational variables									
Desire for more children									
20. Wants no more children	0.67	0.47	2950	0.55	0.50	4963	0.49	0.50	2630
21. (Wants one more child)	0.19	0.39	2950	0.17	0.37	4963	0.36	0.48	2630
22. Wants 2 or more children	0.14	0.35	2950	0.28	0.45	4963	0.15	0.35	2630

Source: Analysis of Bolivia, Egypt and Thailand DHS data *Note: Variables in parentheses are omitted categories in the analysis.*

Table 4 **Bivariate Probit Results: Full Model**

Variable	Bolivia			Egypt			Thailand		
	Coef	SE		Coef	SE		Coef	SE	
DETERMINANTS OF CURRENT MODERN CONTRACEPTIVE USE									
Background variables									
1. Rural/urban residence	-0.0652	0.0961		0.1872	0.0731	*	0.1179	0.0741	
2. Incomplete primary level	-0.0589	0.1456		-0.1320	0.0607	*	-0.1777	0.1214	
3. (Complete primary level)									
4. Secondary or higher	0.2698	0.0762	***	0.1694	0.0603	**	-0.0547	0.0777	
5. Modern toilet facilities	0.1204	0.1063		0.0213	0.0615		-0.0654	0.1541	
6. Mother works for pay	0.0686	0.0781		0.0096	0.0666		0.1434	0.0534	**
Motivational variables									
7. Wants no more children	0.1735	0.0817	*	0.3662	0.0539	***	0.2928	0.0585	***
8. (Wants one more child)									
9. Wants 2 or more children	0.0689	0.1077		-0.0669	0.0565		-0.2990	0.0766	***
Demographic variables									
10. Mother under age 19 at first birth	0.0967	0.0680		0.1725	0.0422	***	0.1301	0.0572	*
11. (Mother aged 19 to 23)									
12. Mother over age 23	-0.1116	0.1211		0.0673	0.0628		-0.2489	0.1216	*
13. Preceding birth interval length	-0.1297	0.0755		-0.2549	0.0424	***	-0.3336	0.0727	***
14. Previous child has died	0.0741	0.0805		-0.0532	0.0428		-0.2135	0.0997	*
15. Previous of use modern contraceptive	0.7930	0.1439	***	0.4956	0.0583	***	0.3946	0.0596	***
Aggregate variables									
16. Oral rehydration therapy knowledge	-0.3191	0.1896		1.3439	0.5707	*	-0.3525	0.2256	
17. Use of health cards	0.1476	0.1860		0.1498	0.2854		-0.0341	0.1337	
18. Additional women in the household	0.1762	0.0774	*	-0.0873	0.0491		-0.1969	0.0719	**
Previous prenatal care use									
19. Prenatal care	1.4622	0.2958	***	1.1394	0.1998	***	0.9959	0.3678	**
DETERMINANTS OF PRENATAL CARE DURING THE LAST BIRTH									
Demographic variables									
1. Mother under age 19 at first birth	-0.0069	0.0578		-0.0823	0.0415	*	-0.1844	0.0734	*
2. (Mother aged 19 to 23)									
3. Mother over age 23	-0.0372	0.0814		0.0085	0.0625		-0.3128	0.1413	*
4. Preceding birth interval length	-0.0010	0.0613		0.1426	0.0433	***	0.2911	0.0850	***
5. Previous child has died	-0.1672	0.0569	**	-0.0531	0.0408		-0.3653	0.0975	***
6. Previous use of modern contraceptive	0.8407	0.1424	***	0.0951	0.0418	*	0.2323	0.0703	***
Background variables									
7. Rural/urban residence	0.3248	0.0599	***	0.3735	0.0458	***	0.6186	0.0985	***
8. Incomplete primary level	-0.5554	0.0678	***	-0.2900	0.0418	***	-0.5210	0.1108	***
9. Modern toilet facilities	0.5212	0.0733	***	0.4013	0.0594	***	0.6500	0.4192	
10. Mother works for pay	0.1341	0.0749		0.0910	0.0659		-0.0407	0.0684	
Aggregate variables									
11. Knowledge of oral rehydration therapy	0.8972	0.1292	***	1.0340	0.4586	*	0.8015	0.2619	**
12. Use of health cards	0.6685	0.1357	***	-0.2960	0.2728		0.7036	0.1621	***
13. Additional women in the household	0.1812	0.0685	**	-0.0369	0.0458		-0.0154	0.0954	
RHO (1,2)	-0.5678	0.1875	**	-0.6838	0.1255	***	-0.4014	0.2050	

Source: Analysis of Bolivia, Egypt and Thailand DHS data.

*Note: a. MLE used for analysis; * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$*

b. Variables in parentheses are omitted categories in the analysis.

In terms of fertility motivation, the consistently significant result in all three countries was that women who had achieved their desired parity were more likely to use contraception than their counterparts who wanted one more child. In Thailand, the effect of wanting two or more children, relative to wanting one more, was significantly negative. Previous use of modern contraceptives was statistically significant and positive in Bolivia, Egypt and Thailand ($p < 0.001$).

Among the other direct effects on subsequent modern contraceptive use are statistically significant positive ones from early age at first birth in Egypt and Thailand, which may reflect active targeting of high-risk pregnancies for health care. Interestingly, previous child loss has no significant direct effect on contraceptive use, except in Thailand. Widespread community knowledge of oral rehydration therapy has a notable positive effect on subsequent contraceptive use in Egypt but is negative for Bolivia and Thailand. Similarly, widespread community use of health cards shows no statistically significant influence on contraceptive use in any of the countries. The presence of other women of childbearing age in the household has a negative influence of contraceptive use everywhere except in Bolivia, but the effect is statistically important in Thailand only. The muted direct influence of the community health contact predictors and previous infant loss is most likely due to the strong direct effect estimated for prenatal care and their indirect effects on contraceptive use through prenatal care as detailed in Table 3.

Independent Variables that Directly Affect Prenatal Care and Indirectly Affect Modern Contraceptive Use

In the second panel of Table 4, we examine independent variables that directly affect prenatal care and indirectly affect subsequent modern contraceptive use through prenatal care. Where strong effects are found for three or more countries, they involve influence from previous use of a modern contraceptive, urban residence, educational level of the mother, widespread knowledge of oral rehydration therapy, and extensive health card use in the respondent's community.

If a woman's previous child had died, its effect on prenatal care was consistently negative in all countries but statistically significant ($p < 0.01$) only in Bolivia and Thailand. The lack of health system contact resulting in the death of a previous child was probably due to some of these determinants influencing non-utilisation of prenatal care.

Previous use of modern contraception is a strong positive determinant of prenatal care everywhere and statistically significant ($p < 0.05$) in Bolivia, Egypt and Thailand. In all three of these countries, women who had previously used modern contraception were more likely to use prenatal care and modern contraceptives after the index birth than those who had not. This result raises a question. In terms of the aggregate variables, interestingly, knowledge of oral rehydration therapy (ORT) was significant across all three countries. Those living in communities with widespread knowledge of oral rehydration therapy were more likely to use prenatal care than women living in communities with less widespread knowledge ($p < 0.001$). The use of health cards by women in the various communities yielded a similar statistically significant result for Bolivia (coefficient size 0.8972), and Thailand (0.8015) but was insignificant for Egypt (1.0340). Both variables make a strong case for the hypothesis that prior health system contact leads to subsequent use of services.

The effects of the background, demographic and aggregate variables on contraceptive use seen earlier are differentially mediated by their effects on prenatal care. Demographic variables tend to maintain strong direct effects on contraceptive use, even though mediated by prenatal care, while background variables show stronger direct effects on prenatal care use. The aggregate variables, which reflect context effects of community and household experience with health care, similarly have stronger direct effects on prenatal care than contraceptive use in all countries except Egypt. For example, the effect of an incomplete primary education on prenatal care use in Bolivia is –0.554; once mediated by prenatal care use, its effect on modern contraceptive use is -0.0589. Similarly, the coefficient for knowledge of oral rehydration therapy (ORT) in Thailand as a determinant of prenatal care is 0.8015, whereas its effect in determining contraceptive use is -0.3525. In contrast, the direct effect of prior contraceptive use in Bolivia and Thiland is, not surprisingly, stronger on contraceptive use even after its effect is mediated through prenatal care use.

Table 5 **Simulation Results**

	Bolivia n = 2925	Egypt n = 4959	Thailand n = 2620
Probability that women will use prenatal care and modern contraception			
Prenatal care	0.6385	0.6206	0.8605
Modern contraception	0.1751	0.3228	0.7498
Probability that women will use modern contraception if either all or no women have prenatal care			
All women have prenatal care	0.2447	0.5497	0.7080
No woman has prenatal care	0.0197	0.5497	0.3495
Probability that women will use prenatal care and modern contraception if all women have previously used modern contraception			
Prenatal care	0.8405	0.6430	0.8849
Modern contraception	0.5963	0.4277	0.8366
Probability that women will use prenatal care and modern contraception if no woman has previously used modern contraception			
Prenatal care	0.6282	0.6098	0.8406
Modern contraception	0.1383	0.2555	0.6758
Probability that women will use prenatal care and modern contraception if all women received secondary level education			
Prenatal care	0.6730	0.6754	0.8717
Modern contraception	0.2010	0.4192	0.7540
Probability that women will use prenatal care and modern contraception if no woman completed primary level education			
Prenatal care	0.4946	0.5721	0.7504
Modern contraception	0.0661	0.2412	0.5668

The ρ statistic shown at the end of each jointly estimated model is a measure of the correlation in the error terms between the two equations. When ρ is zero, there is no simultaneity problem about which to worry, and a simple probit estimator could have been used on the equations. Only in Bolivia and Egypt is prenatal care use statistically endogenous in the expanded model, justifying our use of the bivariate probit estimation. (To maintain consistency in estimation across all three countries, we used bivariate probit estimation throughout.)

Next to Last Birth

Bivariate probit results are not shown for the second to the last birth (or child i-1).[e] The number of eligible women analysed for this model is less than that for the last birth and may be compositionally more homogenous, given the selectivity for women having more than one birth in the five-year period.

[e] *These results are available from the authors.*

The underlying homogeneity constrains the covariance among these factors and reduces the number of coefficients that are statistically significant. We can characterise the findings for next to last birth models as follows. Second, regarding the other country models, the magnitude of the coefficients for Egypt and Thailand are similar to those for the last birth. The prenatal care determinant tends to remain statistically significant for the next to last birth as last birth models. In Bolivia, a number of determinants significantly influence prenatal care received for the next to last child; but although prenatal care itself, as a function of these variables, has a positive influence on modern contraceptive use after this child's birth, the effect is not statistically significant. It is worth noting that the coefficients for previous infant loss and contraceptive use are larger in all country models for contraceptive use following child i-1's birth, as compared with child i's birth. Finally, the ρ statistic empirically confirms the endogeneity of prenatal care as a determinant of subsequent contraceptive use in Egypt. In summary, for both child i and child i-1, prenatal care is a direct and indirect pathway of influence on subsequent contraceptive use in Egypt, while it is consistently not one in Thailand. It is in Bolivia for child i.

Simulations

In order to get some sense of the magnitude of the effects of independent variables on prenatal care and modern contraceptive use, we ran simulations by calculating the adjusted probabilities after manipulating the values of selected variables. To do this, we have taken the sums of the coefficients and multiplied them by actual values of variables for all women for the prenatal care and the family planning equations separately. We normalised the predicted probabilities of contraceptive use and obtaining prenatal care. The results of this show that given present conditions (preceding and during the year the survey was fielded), 64% of pregnant women in Bolivia, 62% of women in Egypt, and 86% of women in Thailand should be using prenatal care. These results are the same as the prenatal care descriptive statistics in Table 2. The predicted probabilities of women using modern contraception are 18% in Bolivia, 32% in Egypt and 75% in Thailand, as compared with the observed modern contraceptive prevalence levels of 13%, 39% and 86% respectively.

Next, we set values for variables, such as prenatal care use, contraceptive use, and educational level to see what their effects would be. The results are shown in Table 5. If all women had obtained prenatal care at the time of the survey, 24% of women in Bolivia would have subsequently used modern contraception, and if no woman had obtained prenatal care preceding the time of the survey, only 2% of the women living in Bolivia would obtain modern contraception. This is compared with the predicted modern contraceptive use probability of 18%. If all of the women living in Egypt were to have obtained prenatal care, 55% would subsequently have used modern contraception, and if no woman had obtained prenatal care preceding the time of the survey, only 18% of the women living in Egypt would use modern contraception. Finally, in Thailand, if all women had obtained prenatal care, 71% would subsequently use modern contraceptives and if none of the women had obtained prenatal care, only a little more than a third (35%) would subsequently use modern contraception.

More women in all countries would use prenatal care and modern contraception if all had used modern contraception earlier, as seen in the third panel of Table 5. Likewise, fewer women in all countries would use prenatal care and modern contraception if no earlier use of contraception occurred (panel 4). However, the differences in the new predicted probabilities in the hypothetical instance that all women would not have used modern contraception are very small when compared with the predicted probabilities based on conditions immediately preceding and at the time of the survey.

Universal secondary education increases modern contraception and prenatal care use. But the differences are slight. Educational levels that are universally limited to the primary level decreases the use of modern contraception and prenatal care, as is shown in Table 5.

Discussion

Bolivia and Egypt operate very similarly in that prenatal care, maternal education, motivation to contracept and previous modern contraceptive use

all have strong effects on current modern contraceptive use. And a myriad of determinants such as health system interaction, maternal education and socio-economic status have strong effects on prenatal care. Both countries make a strong case for integrated programs as facilitators of modern contraceptive use.

In Bolivia, a high level of general health system experience seems to be a very important determinant of prenatal care use, as revealed in the effects of death of a previous child, previous modern contraceptive use, and widespread ORT knowledge and health care use. Prenatal care for the last child is a noticeably strong predictor of mothers' subsequent use of modern contraceptives, suggesting again that a woman's contact with multiple MCH/FP program services can facilitate contraceptive use. By contrast, in Egypt, socio-economic status (as indicated by the educational level of the mother and existence of modern toilet facilities in her household) and residence were more important determinants of prenatal care than general health service contact.

In Thailand, general prior health service contact is an important determinant of prenatal care, as are demographic variables, urban residence and education. Determinants of modern contraceptive use are motivation to contracept, previous modern contraceptive use, and previous prenatal care use. Prenatal care is not found to be an intermediate pathway for other factors to influence contraceptive use, suggesting that there may be common individual factors motivating use of prenatal and family planning services, and prenatal care is a sufficient but not necessary health service contact to facilitate the later adoption of modern contraceptives.

These results beg the question of causality. Prenatal care is a highly statistically significant predictor of subsequent modern contraceptive behaviour in three countries, lending considerable support to our hypothesis; but prior modern contraceptive use is as well and is also a significant predictor of prenatal care. Without full reproductive and health care histories, we cannot be sure whether current users' initial contact with integrated MCH/FP services occurs as a result of seeking prenatal or family planning care. However, regardless of the type of care, motivating initial contact with the integrated MCH/FP system, our findings support the notion that awareness and access to formal health system's multiple services encourage women to utilise both prenatal care and family planning advice and resources.

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REFERENCES

1. Chayovan Napaporn, Peerasit Kamnuansilpa and John Knodel. *Thailand Demographic and Health Survey 1987.* Columbia: IRD/Westinghouse, 1988.
2. Sayed Hussein Abdel-Aziz Helmi, Magued I Osman, Fatma El-Zanaty and Ann A Way. *Egypt Demographic and Health Survey 1988.* Colombia: IRD/Macro Systems Inc., 1989.
3. Sommerfelt AE, JT Boerma, LH Ochoa and SO Rutstein. *Maternal and Child Health in Bolivia: Report on the In-depth DHS Survey in Bolivia, 1989.* Columbia: Institute for Resource Development/Macro Systems, Inc., 1991.
4. Population Reference Bureau. *World Population Data Sheet.* Washington: Population Reference Bureau, 1992.
5. Stewart Kate and A Elizabeth Sommerfelt. Utilization of maternity care services: a comparative study using DHS data. In: *Demographic and Health Surveys World Conference.* Proceedings Volume III. Columbia: Demographic and Health Surveys, 1991, 1645–1667.
6. Walsh Julia, Chris Feifer, Anthony Measham and Paul Gertler. Maternal and perinatal health. In: Dean Jamison, W Henry Mosley, Anthony Measham and Jose Luis Bobadilla (Eds.). *Disease Control Priorities in Developing Countries.* New York: Oxford University Press, 1993, 363–390.
7. Mburu FM and JT Boerma. Maternal and child health services in eastern and southern Africa: progress and prospects. *Demographic and Health Surveys World Conference.* Proceedings. Volume III. Columbia: Demographic and Health Surveys, 1991, 1455–1474.

8. Becker Stan, David Peters, Ronald Gray, Connie Gultiano and Robert Black. The determinants of use of maternal and child health services in Metro Cebu, the Philippines. *Health Transition Review* 1993; 3(1): 77–89.

9. Rooney Cleone. *Antenatal Care and Maternal Health: How Effective Is it?* Geneva: World Health Organization, Division of Family Health, 1992.

10. Alisjabana Anna. The implementation of the risk approach in maternal and child health services. In: Helen Wallace and Kanti Giri (Eds.). *Health Care of Women and Children in Developing Countries.* Oakland: Third Party Publishing Company, 1990, 382–392.

11. Williams Cicely, Naomi Baumslag and Derrick Jelliffe. *Mother and Child Health: Delivering Services.* New York: Oxford University Press, 1994.

12. Jamieson Denise J and Paul A Buescher. The effect of family planning participation on prenatal care use and low birth weight. *Family Planning Perspectives* 1992; 24(5): 215–218.

13. Instituto Nacional de Estadistica and Institute for Resource Development/Macro Systems. *Encuesta Nacional de Demografia y Salud 1989.* Columbia: Institute for Resource Development/Macro Systems, 1990.

14. Sittitrai Werasit, Kua Wongboonsin and Pichit Pitaktepsombati. *A Study on Some Organizational Issues in Community Participation in the Context of a National Family Planning Programme: the Case of Thailand.* Bangkok: Institute of Population Studies, Chalalongkorn University, 1989.

15. Pitaktepsombati P and Wongboonsin K. Maternal health care: recent trends, differentials and correlates. In: *Health and Population Studies Based on the 1987 Thailand Demographic and Health Survey.* Bangkok, Thailand, Chulalongkorn University, Institute of Population Studies, 1989.

16. Chayovan Napaporn and John Knodel. Contraceptive initiation patterns in Thailand. In: *Health and Population Studies Based on the 1987 Thailand Demographic and Health Survey,* 99–122.

17. Bollen Kenneth A, David K Guilkey and Thomas Mroz. Binary outcomes and endogenous explanatory variables: tests and solutions with an application to the demand for contraceptive use in Tunisia. *Demography* 1995; 32: 111–131.

18. Elo Irma. Utilization of maternal health-care services in Peru: the role of women's education. *Health Transition Review* 1992; 2(1): 49–69.

19. Bicego George and JT Boerma. Maternal education and child survival: A comparative analysis of DHS data. *Demographic and Health Surveys World Conference.* Proceedings Volume I. Columbia: Demographic and Health Surveys, 1991, 177–204.

20. Hobcraft John. Women's education, child welfare and child survival: a review of the evidence. *Health Transition Review* 1993; 3(2): 159–175.

21. Caldwell John. Maternal education as a factor in child mortality. *World Health Forum* 1981; 2: 75–78.

22. National Academy of Sciences/National Research Council. *Contraception and Reproduction: Health Consequences for Women and Children in the Developing World.* Washington DC: National Academy Press, 1989.

23. Bollen Kenneth A, David K Guilkey and Thomas Mroz. Methods for evaluating the impact of family planning programs in structural models. Evaluation Project Working Paper, Carolina Population Center, 1992.

24. Forste Renata. The effects of breastfeeding practices and contraceptive use on infant and child mortality as mediated through birth spacing in Bolivia. Dissertation, University of Chicago, 1992.

25. Guilkey David K. Multilevel and panel models and their use in the measurement of program impact. Unpublished manuscript, 1993.

26. Guilkey David K, Thomas A Mroz and Larry Taylor. Estimation and testing in simultaneous equation models with discrete outcomes using cross sectional data. Evaluation Project Working Paper, Carolina Population Center, 1992.

27. Phuapradit W, S Pongthai, S Sudhutoravut, K Chaturachinda and V Benchakan. Implementation of risk approach in maternal health. In: Helen M Wallace and Kanti Giri (Ed). *Health Care of Women and Children in Developing Countries.* Oakland: Third Party Publishing Company.

28. Prasith-Rathsint Suchart. Fertility control policies in Thailand. In: K. Mahadevan (Ed.). *Fertility Control Policies of Asian Countries.* New Delhi: Sage Publications, 1989.

29. Sawangdee Yothin. Personal communication. Carolina Population Center, 1994.

30. Wilkinson Marilyn I, Wamucii Njogu and Noureddine Abderrahim. *The Availability of Family Planning and Maternal and Child Health Services.* Columbia: Macro International, 1993.