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Does prenatal care benefit maternal health?

A study of postpartum maternal care use

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Probability of postpartum re-hospitalization was reduced significantly
It droped 43.8% among women who had vaginal delivery
Pregnant women receiving prenatal care see a significant impact on maternal health

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The data set used in this study consists of de-identified secondary data released to the public for research purpose.

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Abstract

Most studies on prenatal care focus on its effects on infant health while studying less about the effects on maternal health. Using the Longitudinal Health Insurance claims data in Taiwan in a recursive bivariate probit model, this study examines the impact of adequate prenatal care on the probability of postpartum maternal hospitalization during the first six months after birth. The results show that adequate prenatal care significantly reduces the probability of postpartum maternal hospitalization among women who have had vaginal delivery by 43.8%. This finding suggests that the benefits of prenatal care may have been underestimated among women with vaginal delivery. Timely and adequate prenatal care not only creates a positive impact on infant health, but also yields significant benefits for postpartum maternal health. However, we do not find similar benefits of prenatal care for women undergoing a cesarean section.

Keywords: prenatal care, maternal health, postpartum, vaginal delivery, Taiwan

1. Introduction

The role of the quality of human capital in sustainable economic development cannot be overemphasized, with health being one of the most important components of human capital. As is commonly stated, children are the future of a nation, and the quality of their early life affects their future accumulation of human capital [1-3]. Indeed, one's health at birth is a valuable predictor of important future outcomes, such as earnings, education, and disability [4]. Consequently, the provision and promotion of prenatal care is one of the most important and common government interventions.

Prenatal care theoretically provides benefits in two ways. First, an early detection of disorders allows physicians to take action in order to try and prevent premature births or neonatal deaths. Second, education and counseling during prenatal care help pregnant women maintain a healthy diet and lifestyle, which naturally can promote infant health and early childhood development as well as decrease postpartum maternal health problems. While these potential benefits most likely foster the health of both the mother and child, surprisingly, the literature has largely focused on the determinants of their utilization and the effects on newborns [5-8], with only a few studies investigating the impact of prenatal care on maternal health [9-10].

For policy-makers to determine the true utility or effectiveness of prenatal care programs, any evaluation should also account for their effects on both children and their mothers. Despite the wealth of literature on the effects of prenatal care on infant health, the conclusion is still not yet definitive. Traditionally, it is generally believed that prenatal care should improve newborn health, as suggested by earlier studies. For example, Gortmaker [11] finds that inadequate prenatal care is associated with higher risks of low birth weight for infants of white mothers who delivered in non-private general service hospitals and for all black mothers. The Institute of Medicine [12] also advocates the use of prenatal care as a cost-saving health intervention, precisely due to its protective effects at reducing low birth-weight infants.

Some recent studies, however, have argued that the effects of prenatal care on birth outcomes are very limited [8,13], or that the effects of prenatal care are not uniform across all types of pregnancies [14-16]. Acknowledging this, Conway and Deb [17] estimate the effects of prenatal care with a finite mixture model to allow for different effects on various types of pregnancies and show that there is a substantial effect on normal pregnancies, but not on complicated pregnancies. Given the benefits of prenatal care, the obvious next question is: what determines the utilization of prenatal care? This has been widely studied in both developed and developing countries [5-7, 18-19].

The impact of prenatal care on maternal health, in contrast to the vigorous discussions of its effects on newborns, has been surprisingly poorly documented, perhaps because many take it for granted. A relevant research conducted in the U.S. by Conway and Kutinova [9] provides evidence suggesting that receiving timely and adequate prenatal care could help prevent mothers from being overweight or underweight, as well as help them avoid prolonged hospitalization after the delivery. However, their study does not control for mode of delivery (vaginal delivery versus cesarean section) and hence the risk of delivery, which is highly related to the hospital length of stay. Another study by Reichman et al. [10] investigates the effects of prenatal care on maternal postpartum parenting behaviors, finding that first-trimester prenatal care not only increases the likelihood of more well-baby visits and breastfeeding, but also reduces the prevalence of postpartum maternal smoking. The lack of a general measure of maternal health, however, prevents them from analyzing the effects of prenatal care on maternal health.

This present paper aims to explore the effects of prenatal care on postpartum maternal health, as indicated by inpatient maternal care use. Taiwan's universal health care system, with its detailed electronic claims database, lends itself as a good candidate for such a study. Using longitudinal health insurance claims data in Taiwan, this study examines the impact of adequate prenatal care on the probability of maternal re-hospitalization incidence during the first six months after birth. The estimation method adopted is a recursive bivariate probit model. In addition, our study divides the

sample population into two types of delivery - vaginal delivery and cesarean section - in order to distinguish differences in the impact of prenatal care between these two groups of mothers.

The results show that adequate prenatal care use significantly reduces the probability of mothers who underwent vaginal delivery being readmitted to hospitals for maternal health problems within the first 6-month postpartum period. However, we see no significant evidence for similar effects for mothers who had a cesarean section. This finding underlines the importance of adequate prenatal care on postpartum maternal health, particularly for women who had vaginal delivery. If we only consider the effects on the infant outcomes, the benefits of prenatal care will be underestimated.

The rest of the paper is organized as follows. The next section summarizes the maternal medical care in Taiwan, followed by the methodology section, which describes the study's setting, data, and empirical strategy used. Section 4 presents and discusses the empirical results. Section 5 concludes the study.

2. Maternal medical care in Taiwan

Taiwan implemented the National Health Insurance (NHI) program in 1995, with a generous maternal care benefit package, including free prenatal care, free delivery services, and postnatal care with little copayment for pregnant women - only a small registration fee of US$3-10 (NT$100-300) per visit. Prenatal services are quite comprehensive, as summarized below.

1. A total of 10 prenatal visits and physical check-ups (two visits before the 17th week, two visits during the 17th and 28th weeks, and six visits after the 28th week).
2. Regular blood and urine tests.
3. Lab tests for syphilis, HIV, hepatitis B, and rubella.
4. Sonography in the 20th week.
5. Screening for gestational diabetes.
6. Behavior counseling to promote a healthy diet and lifestyle.

7. Genetic counseling for women 34 years of age or older or for women at high risk for having babies with congenital disorders.

3. Methodology

3.1 Data

The data are selected from the Longitudinal Health Insurance Database (LHID) in Taiwan. Under NHI, all contracted providers must submit claims electronically for reimbursement. The National Health Research Institute (NHRI) then assembles these claims and prepares them into a workable format for analysis. LHID is a sub-set of this database and contains all claims, including both outpatient and inpatient visits, for one million individuals randomly selected from the beneficiaries enrolled in 2005. As NHI covers more than 99% of the Taiwanese people, the sample is highly representative of the total population. The claims data are similar to the inpatient claim files for Medicare beneficiaries in the United States and contain detailed information on the services provided, the diagnoses (ICD-9 code), the date and duration of each service, total expenditure of each visit and its detailed breakdown, and the age and sex of the beneficiary.

We identify women who gave birth in 2005 as our study sample via the diagnosis-related group (DRG) codes and separate the observations into two groups - vaginal delivery (DRG=0371A) and cesarean section (DRG=0373A, 0373B) - to compare how the differences in prenatal care use can impact postpartum maternal health. Using the unique identifier of each beneficiary, we further link their records of prenatal care utilization within 40 weeks prior to their deliveries, all health service utilizations in the prior year of 2004, and all medical claims during the post-partum period of the first six months after the delivery. From the dataset of outpatient care use, we can identify whether the pregnant women used timely prenatal care and are able to calculate the number of visits for such preventive care use for each mother during pregnancy, based on the specific codes assigned to each prenatal care visit.

To assess the adequacy of prenatal care use, we construct a variable based on the Kessner Index, which was developed and recommended by the Institute of Medicine in 1973 to evaluate the level of adequate prenatal care [20]. Under this index, a woman is considered to have received inadequate prenatal care if one of the following conditions is met.

1. She had not received any prenatal care by the 16th week of pregnancy.
2. She had only one prenatal care visit or less by the 20th week of pregnancy.
3. She had only two or less prenatal care visits by the 28th week of pregnancy.
4. She had only three or less prenatal care visits by the 32nd week of pregnancy.
5. She had only four or less prenatal care visits by the 34th week of pregnancy.

If a woman does not meet any of the above conditions, then she is considered to have received adequate prenatal care.

3.2 Empirical model

According to the previous studies' findings that adequate utilization of prenatal care could benefit maternal health, we hypothesize that adequate prenatal care use has a negative impact on the probability of post-partum re-hospitalization and hence the coefficient of adequate prenatal care is expected to be negative.

Given the universal coverage provided by NHI and its generous maternal care benefit package, pregnant women in Taiwan face a low financial barrier when seeking prenatal care. Hence, there seemingly should be no significant variation in prenatal care utilization across socioeconomic status and the utilization of adequate prenatal care could potentially be treated as an exogenous variable. However, based on Liu and Chen [7], the demand for prenatal care in Taiwan could potentially be affected by maternal characteristics, geographic locations, and provider characteristics. Therefore, we treat the utilization of prenatal care as an endogenous variable in our empirical

estimation in order to obtain unbiased and consistent estimates and employ a bivariate probit model to address the potential endogeneity problem, if there is one.

Our empirical model deploys recursive bivariate probit estimation procedures to jointly estimate the adequate use of prenatal care and post-partum inpatient maternal care utilization to allow for a correlation between the two binary outcomes, as driven by a number of common supply- or demand-side factors. The model is specified as follows:

$$Y_1 = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \varepsilon \quad (1)$$

$$Y_2 = \beta_0 + \beta_1 Y_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \beta_5 X_4 + \mu, \quad (2)$$

where Y_1 is a dummy dependent variable of adequate prenatal care that equals 1 if the mother received adequate prenatal care during pregnancy, and 0 otherwise; Y_2 is another dummy dependent variable of re-hospitalization due to maternal conditions that equals 1 if the mother had been re-admitted to the hospital during the first six-month postpartum period, and 0 otherwise; X_1, X_2, X_3 and X_4 are four vectors of independent variables - maternal age, geographic location, physician's gender, and physician's age, respectively - that affect both the probability of adequate prenatal care use and re-hospitalization due to maternal conditions and are included in equations (1) and (2). As Conway (2006) suggests, we also include additional variables in the prenatal care equation, such as insurance enrollment category (X_5) and baseline maternal health, as proxies for health expenditures during the prior year of 2004 (X_6). The insurance enrollment category in Taiwan's NHI is contingent on the beneficiary's employment status and occupation and therefore could serve as a proxy for the socioeconomic status of an individual. Additionally, type of provider facility (X_7), categorized as clinic, district hospital, regional hospital, and medical center, is also included in equation (1), but not equation (2), as it may only affect adequate prenatal care use and not post-partum inpatient care utilization [21]. This is because clinics provide prenatal care, but do not provide inpatient services.

Finally, α_0 and β_0 are constants; α_1-α_7 and β_1-β_5 are the vectors of coefficients; and ε and μ are the residuals. Table 1 presents the detailed definition of variables.

The results will not be efficient if ε and μ are correlated and equation (1) and equation (2) are not estimated concurrently. We perform a likelihood ratio test of $\rho=0$ to examine the correlation between ε and μ. The results of the test show that $\chi^2(1)=6.86$, rejecting the null hypothesis of $\rho=0$. Therefore, the two equations cannot be estimated separately. This verifies the validity of using the bivariate probit model for the estimation.

<Table 1>

4. Results

4.1 Descriptive statistics

Table 2 reports the summary statistics of the sample. After deleting the missing values, there are 8,222 women in our study sample: 5,403 (65.71%) who underwent vaginal delivery and 2,819 (34.29%) who underwent a cesarean section. On average, compared to vaginal delivery, those with a cesarean section have a slightly higher probability of receiving adequate prenatal care (70.49% vs. 67.52%), a higher maternal age (30 year or older, 53.18% vs. 40.37%), lower baseline health expenditures (NT$74,952 vs. NT$77,982), and a greater likelihood of living in the North or South (75.38% vs. 70.91%). The two groups have a similar insurance enrollment status and provider characteristics.

<Table 2>

Table 3 presents the probability of re-hospitalization and the mean medical expenditures of mothers with vaginal delivery and cesarean section during the first six-month postpartum period.

Overall, women who underwent vaginal delivery are less likely to be readmitted for maternal conditions (0.59% vs. 0.67%) and have a lower post-partum medical expenditure (NT$19,122; US$1=NT$30) than those who had a cesarean section (NT$32,310). Among mothers who underwent vaginal delivery, those who received adequate prenatal care have a lower probability of being re-admitted to the hospitals than those with inadequate prenatal care (0.49% vs. 0.80%). Similarly, the postpartum medical expenditures among mothers with adequate prenatal care use are 51.2% lower than those with inadequate use (NT$13,111 vs. NT$26,849). Surprisingly, among mothers who underwent a cesarean section, the percentage of postpartum re-hospitalization is higher (0.75%) for those with adequate prenatal care, compared to women with inadequate prenatal care (0.48%). Nevertheless, their total amounts of postpartum medical expenditures are very similar (NT$32,288 vs. NT$32,392)

<Table 3>

4.2 Recursive bivariate probit results

Table 4 reports the results of the two equations in the recursive bivariate probit estimation. Here, we include the estimated effect of adequate utilization of prenatal care on the likelihood of postpartum maternal re-hospitalization during the first six months after birth, for mothers of vaginal delivery and cesarean section, respectively.

For prenatal care use, the results are fairly similar between the two modes of delivery. The two most significant drivers of receiving adequate prenatal care are geographical location and type of provider facility: 1) mothers who gave birth in the Central region are least likely to have received adequate prenatal care while women from other regions are either more likely (East) or on par (South) with those who gave birth int the North; 2) the larger the provider facility is that the pregnant women visited, the higher the probability is that she received adequate prenatal care. In addition, physician gender also affects the use of prenatal care - women with male physicians are more likely to have

received adequate prenatal care.

We find that most demand-side variables in our analysis, including maternal age, insurance enrollment category as a proxy for socioeconomic status, and baseline health expenditures, have no significant relationship with adequate prenatal care use. The lack of significant demand-side determinants of adequate prenatal care is consistent with the limited financial barriers for pregnant women to seek maternal health care services in Taiwan's universal health care system.

For the second equation of the recursive bivariate probit model, the results show that adequate prenatal care significantly reduces the likelihood of postpartum maternal re-hospitalization during the first six months post-delivery among the vaginal delivery group of mothers. The coefficient of adequate prenatal care in the empirical model is found to be -0.80 and significant at the 1% level. This supports our hypothesis that mothers who have received adequate prenatal care have a lower probability of re-hospitalization due to maternal conditions, suggesting a protective effect on postpartum maternal health, and it is partially consistent with the findings of Conway and Kutinova [9]. The magnitude of the coefficient translates into a marginal effect of a reduction by 0.35 percentage points in readmission for mothers who underwent vaginal delivery - that is, the protective effects of adequate prenatal care reduce the risk of readmission for these mothers by 43.8%, given its baseline probability of 0.80%

We do observe no significant effect among women who had a cesarean section. The lack of a discernible role for prenatal care is intriguing, but in fact could be expected from a medical perspective - women choose to undergo a cesarean section for a specific reason, which is often a clinical issue that emerges in the last stage of their pregnancy. Postpartum hospitalization in this group is more likely to be associated with the same medical reason that leads to the cesarean section, or even due to the cesarean section itself, as the operation presents significant risks to maternal health [22, 23]. The discrepancy of impact between the two groups of mothers implies that the estimated effect found in earlier studies, where the mode of delivery is not distinguished, could be

underestimated for women who underwent vaginal delivery. This also underlines the importance of distinguishing the mode of delivery in studying the effects of prenatal care, which is consistent with the findings of Conway and Deb [17], whereby failing to separate out 'complicated' from 'normal' pregnancies can lead to a false conclusion on the benefits of prenatal care.

The coefficients for the rest of the independent variables in the model's second equation do not reach a significance level ($p>0.05$). This implies that hospitalization for maternal conditions during the period following the delivery is likely to be driven predominantly by medical necessities, rather than demand- or supply-side characteristics, in the context of this study where financial access to medical care is mostly out of the question.

<Table 4>

4.3 Robustness check

To ensure the robustness of our results, we also deploy a two-equation simultaneous model, with the determinants of adequate prenatal care in the first equation, to serve as a robustness check. As Wooldridge [24] indicates, when dependent variables are dichotomous, even though the two-stage simultaneous equation model is vulnerable in estimating the magnitude of the coefficients, it does yield valid conclusions on the signs of effects and tests of significance.

In this empirical model, to address the endogeneity issue whereby a number of factors could affect both prenatal care use and need for postpartum inpatient services, we first estimate the predicted value of adequate prenatal care use by a probit technique in the first stage. The fitted values are then applied in the second equation to isolate the effect in question. Results from this two-step estimator are fairly consistent with what we find in the bivariate probit model (Appendix) - that is, adequate prenatal care leads to a lower probability of readmission among mothers who gave birth via vaginal delivery, and yet no such relationship is found among their counterparts who had a cesarean section.

5. Conclusion

This study has looked to address the understudied and yet critical issue regarding the effects of prenatal care on maternal health. While timely and adequate prenatal care has been found to play a significant role in infant health [25-27], documentation of its impact on maternal health is very limited. Our results underline the importance of prenatal care on postpartum maternal health, as evidenced by its protective effects against maternal hospitalization during the first six-month postpartum period, especially for those who underwent vaginal delivery. Therefore, we support the argument of Conway and Kutinova [9] that the benefits of prenatal care are likely underestimated, and that the value and success of prenatal care programs across countries have to be carefully reconsidered.

In a country like Taiwan where financial barriers to maternal care have largely been removed through its universal coverage of health care and generous benefit package, we still find approximately 30% of mothers do not get adequate prenatal care. One of the main reasons could be attributed to the ignorance of the benefits of prenatal care on maternal health. Conceivably, for pregnant women living in countries where access to maternal care does present a challenge financially, the proportion of mothers with adequate prenatal care would be even lower, leaving a significant amount of avoidable health loss unaddressed. Despite the lack of a formal cost-benefit analysis, our research strongly supports that policy-makers should expand the breadth of prenatal care services given their benefits toward newborns as well as their mothers.

There are several limitations to our study. First of all, our data are claims in nature and do not allow us to fully explain the variation in prenatal care use. The LHID database provides the best nationally representative information in Taiwan that we believe can answer our research question, particularly given its accurate account of both the frequency and timing of prenatal care visits, as

well as the utilization of inpatient and outpatient health services. However, a few potential factors found to be associated with prenatal care use in earlier studies could not be accounted for explicitly herein. For example, the database contains little information on obstetric history, including previous pregnancies. Their effects could have been captured by variables already included in the model, e.g. women who have experienced complications in their previous pregnancies are likely to visit medical centers rather than clinics for prenatal care and this could drive the higher level of adequate prenatal care use in larger medical institutions. Moreover, despite our best efforts to include a proxy indicator of socioeconomic status, we still do not have direct measurements of socioeconomic status, such as education and income, for the mothers or their households.

Second, as Conway and Kutinova [9] point out, the general lack of agreed-upon maternal health measures still presents significant challenges to studies in this area. The maternal outcome we employ reflects only short-term and major impacts on maternal health. Adequate prenatal care may well bring benefits to mothers that are longer-term, more subtle, or beyond the avoidance of hospitalization. Future studies will benefit from more research into better measurement(s) of health that could present a more holistic picture of mothers' physical and mental well-being.

Another limitation in our measurement of prenatal care utilization is that what we capture is more the quantity and not the quality of the services. By accounting for the timing of the services, the "adequacy" or "timeliness" of prenatal care certainly provides more information on what mothers actually receive than simply the amount of services they utilized. Nevertheless, it is undeniable that not all timely prenatal care services are of equal quality. This is to a certain degree, in econometric terms, a measurement error that could potentially bias the analysis results toward null. If this is indeed the case, then our impact estimates would be on the conservative end and the actual maternal health benefits from quality prenatal care could be even higher.

Given the limitations discussed above, the results of our study provide suggestive estimates of a positive impact magnitude yielded by prenatal care. However, with our empirical approach to

account for various factors on the demand and supply sides, as well as the robustness check with the two-stage estimator, it is clear that adequate prenatal care is in fact beneficial for the well-being of the vaginal delivery group of mothers. More studies should be encouraged to explore the cost-effectiveness and cost-saving potential of prenatal care, while at the same time governments around the world need to more actively promote the use of prenatal care and reach out to women who might have difficulties in seeking prenatal care so as to improve the health of both newborns and mothers.

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Variables
Dependent variables
Re-hospital

Table 1 Definition of variables

Definitions	
	Mother was re-admitted to the hospital during the first six months after birth; yes=1, others=0.
Expenditure	The maternal care expenditures in the first six months after birth; yes=1, others=0.
Independent variables	
Adequate pc	Mothers received adequate prenatal care use; yes=1, others=0.
Maternal age	
Mage24	Mothers aged 24 or below; yes=1, others=0 (the reference category)
Mage2529	Mothers aged 25 to 29; yes=1, others=0
Mage3034	Mothers aged 30 to 34; yes=1, others=0
Mage35	Mothers aged 35 or more; yes=1, others=0
Insurance category	
Category1	Civil servants or government employee, self-employed persons, employers, employees of public or private enterprises; yes=1, others=0 (the reference category)
Category2	Members of professional associations without specific employers, seamen serving on foreign vessels; yes=1, others=0
Category3	Members of farmers' or fishermen's associations; yes=1, others=0
Category4	Military personnel; yes=1, others=0
Category5	Low-income household; yes=1, others=0
Category6	Veterans, veterans' dependents, community population; yes=1, others=0
Pre-expenditure	Medical expenditure in 2004
Geographic location	
North	Mothers gave birth in Keelung City, Taipei County, Ilan County, Taoyuan County, Hsinchu County, Miaoli County and Taipei City; yes=1, others=0 (the reference category)
Center	Mothers gave birth in Taichung County, Chunghua County, Nantou County, Yunlin County, and Taichung City; yes=1, others=0
South	Mothers gave birth in Chiayi County, Tainan County, Kaohsiung County, Pingtung County, Kaohsiung City, Chiayi City, and Tainan City; yes=1, others=0
East	Mothers gave birth in Taitung County, Hualien County and Penghu County; yes=1, others=0
Hospital level	
Medical center	Medical institutions with at least 500 beds; yes=1, others=0 (the reference category)
Regional hospital	Medical institutions with 250-499 beds; yes=1, others=0
District hospital	Medical institutions with 20-249 beds; yes=1, others=0
Clinics	Medical institutions with 19 or less beds; yes=1, others=0
Physician's gender	Physician's gender; male=1, female=0
Male	
Physician's age	
Page40	Physician aged 40 or below; yes=1, others=0
Page4150	Physician aged 41 to 50; yes=1, others=0
Page51	Physician aged 51 or above; yes=1, others=0 (the reference category)

Table 2 Characteristics of the sample: vaginal delivery vs. cesarean section

	Vaginal delivery (N=5403)	Cesarean section (N=2819)
Adequate prenatal care(%)	67.52	70.49
Maternal age(%)		
Mage24	22.04	13.44
Mage2529	37.59	33.38
Mage3034	30.19	33.95
Mage35	10.18	19.23
Insurance category(%)		
Category1	64.28	62.22
Catergory2	13.36	14.47
Catergory3	8.79	7.63
Catergory5	0.39	0.14
Catergory6	13.18	15.54
Pre-expenditure(Mean)	77982	74952
Geographic location(%)		
North	44.96	47.04
Center	27.00	22.45
South	25.95	28.34
East	2.09	2.16
Hospital level(%)		
Medical center	15.31	16.28
Regional hospital	25.47	23.80
District hospital	26.61	26.29
Clinics	32.61	33.63
Physician's gender(%)		
Male	91.73	92.55
Female	8.27	7.45
Physician's age(%)		
Page40	26.91	26.29
Page4150	56.75	54.88
Page51	16.34	18.84

Table 3 Sample descriptive statistics between adequate prenatal care and re-hospitalization by different mode of delivery

	Vaginal Delivery		Cesarean Section	
	Re-hospital	Expend(NT$)	Re-hospital	Expend(NT$)
Total	0.59%	19122	0.67%	32310
Adequate pc				
Yes	0.49%	13111	0.75%	32288
No	0.80%	26849	0.48%	32392
Observations	5,403(65.72%)		2,819(34.29%)	

Note: NT$30=US$1

Table 4 Recursive bivariate Probit regression results between adequate prenatal care and six-month postpartum re-hospitalization

Independent Variables	Dependent Variables			
	Vaginal delivery		Cesarean section	
	Adequate	Re-hospital	Adequate	Re-hospital
Constant	0.84**	-2.99**	0.75**	-2.59**
	(0.10)	(0.31)	(0.15)	(0.35)
Adequate pc		-0.80**		1.23
		(0.30)		(0.68)
Maternal age				
Mage2529	-0.02	0.19	-0.04	-0.33
	(0.05)	(0.17)	(0.08)	(0.26)
Mage3034	-0.03	0.22	-0.09	-0.21
	(0.05)	(0.18)	(0.08)	(0.22)
Mage35	0.11	0.05	-0.04	0.08
	(0.07)	(0.24)	(0.09)	(0.21)
Insurance category				
Catergory2	0.01		-0.06	
	(0.05)		(0.07)	
Catergory3	0.07		-0.14	
	(0.07)		(0.10)	
Catergory5	-0.02		-0.76	
	(0.30)		(0.67)	
Catergory6	-0.02		0.02	
	(0.05)		(0.07)	
Pre-expenditure	0.01		-0.01	
	(0.001)		(0.001)	
Geographic location				
Center	-0.25**	0.25	-0.29**	0.30
	(0.04)	(0.14)	(0.06)	(0.21)
South	0.001	0.02	0.05	0.26
	(0.05)	(0.15)	(0.06)	(0.19)
East	0.34*	0.33	0.64**	0.47
	(0.14)	(0.29)	(0.22)	(0.46)
Hospital level				
Regional hospital	-0.36**		-0.21*	
	(0.06)		(0.09)	
District hospital	-0.69**		-0.39**	
	(0.06)		(0.09)	
Clinics	-0.72**		-0.47**	
	(0.06)		(0.08)	
Physician's gender				
Male	0.14*	0.03	0.20*	-0.39
	(0.07)	(0.23)	(0.10)	(0.23)
Physician's age				
Page40	0.11	-0.17	0.09	-0.22
	(0.06)	(0.18)	(0.08)	(0.23)
Page4150	0.09	-0.05	0.02	-0.05
	(0.05)	(0.16)	(0.07)	(0.19)
Observations	5,403		2,819	

Coefficient estimates (standard error in parentheses)
* significant at 5%; ** significant at 1%

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