

Taiwan's High Rate of Cesarean Births: Impacts of National Health Insurance and Fetal Gender Preference

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Abstract: **Background:** Taiwan has a high rate of cesarean section, approximately 33 percent in the past decade. This study investigates and discusses 2 possible factors that may encourage the practice, one of which is fetal gender difference and the other is Taiwan's recently implemented National Health Insurance (NHI). **Methods:** A logistic regression model was used with the 1989 and 1996 National Maternal and Infant Health Survey and with the 2001 to 2003 NHI Research Databases. **Results:** Using survey data, we found a statistically significant 0.3 percent gender difference in parental choice for cesarean section. However, no statistically significant difference was found in the rate of cesarean section before and after NHI implementation. **Conclusions:** Taiwan's high cesarean section rate is not directly related to financial incentives under NHI, indicating that adjusting policy to lower financial incentives from NHI would have only limited effect. Likewise, focusing effort on the small gender difference is unlikely to have much impact. Effective campaigns by health authorities might be conducted to educate the general population about risks associated with cesarean section and the benefits of vaginal birth to the child, mother, and society. (BIRTH 34:2 June 2007)

Key words: fetal gender, National Health Insurance, cesarean section

The high rate of cesarean section births is a worldwide public health concern. Taiwan has among the highest rates with an average for this decade of approximately 33 percent. This rate is 10 percent higher than rates in

Hong Kong and Japan and comparable with those from Latin America. It also far exceeds the recommended 15 percent made by the World Health Organization (1,2). In the past decade, the rate in Taiwan has varied between 33 and 35 percent; and in 1994, the rate was 33.12 percent. The following year, when Taiwan's National Health Insurance (NHI) was implemented, the rate rose slightly to 33.68 percent, then decreased in the following 2 years to 33 percent. In 2000, the year of the fortuitous Chinese astrological sign of the dragon, the rates rose to 34.47 percent (3).

The evidence of morbidity and mortality associated with cesarean delivery is clear. In newborns, complications include pulmonary hypertension and respiratory distress syndrome. Mothers may experience increased hospitalization from uterine infections, complications with obstetric surgical wounds, and cardiopulmonary and thromboembolic conditions. To encourage a lower rate, the Taiwanese Department of Health suggests a 30 percent ceiling on cesarean section rates for all hospitals, linking this recommendation with hospital accreditation guidelines. Although information on

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factors contributing to this increase was of policy interest, minimal research has been conducted to date.

Researchers in the West who have studied the problem found that the decision for surgery was linked to clinical conditions, women's demographics, insurance, hospital setting, and physician characteristics (4–9). Little attention has been placed on the association between fetal gender and cesarean section. One study, however, reported finding a strong association between fetal gender and mode of delivery, positing that male infants were more likely to require instrumental vaginal delivery or cesarean section, possibly because of their larger head size (10).

We hypothesize that in Taiwan, gender difference in choice of delivery is related to an Asian cultural preference for sons. This form of gender discrimination could lead to more cesarean sections prompted by increased concern over a baby boy's health and more superstitious vested interest in the boy being born on a lucky day.

Traditionally, Asian countries have a strong cultural preference for boys over girls. This preference has been identified as contributing to higher female infant mortality in the region (11). Many Taiwanese parents wish to have at least one son to continue their family line. Compared with the 1.05 average international level, the ratio of male newborns to female in Taiwan is around 1.09. This ratio and other birth statistics show interesting trends around lucky years. The year 2000, the year of the dragon, was such a year. Many Taiwanese people want to give birth during the dragon year, the most fortunate year, because they believe this birthday would bring their babies a brighter future life. The ratio of male to female newborns increased from 1.091 (1999) to 1.097 in 2000, dropping the following year to 1.087 (3). Daily average deliveries likewise showed this trend. In 1999, the daily average was 488, 531 in 2000 then 464 the following year (2001) (3).

Traditionally, fortune is not only simply ascribed to a year but also to exact date and time. This belief may lead to the use of cesarean section to make sure that babies are born on one of those days. The belief may be related to the finding that prevalence of cesarean sections was higher in 2000 (34.47%) than in 1999 (33.99%) or in 2001 (32.74%) (3).

Ultrasound examinations are a routine part of prenatal care in Taiwan. All women (100%) used such screening services and could know the gender of their babies before delivery (12). Since it is a cultural characteristic for parents always to want to know the infant gender, the use of ultrasound examinations is deeply believed to lead to increased requests for cesarean section delivery for baby boys. After the NHI was implemented, the percentage of pregnant women

receiving more than 5 ultrasound examinations was increased from 54.4 to 71.5 percent (12). It is rumored that on finding out they will have a boy, many Taiwanese parents request cesarean section to ensure that their child will be born on the most fortunate day. This practice has not, however, been explored empirically. Therefore, one goal of this study was to examine whether gender preference for boys over girls leads to differences in choosing to have a cesarean section in Taiwan.

A second goal of this study was to examine the relationship of NHI coverage on rate of cesarean section. In Latin America, insurance schemes contribute significantly to demand for cesarean section (13). Likewise, Taiwan NHI birth delivery policies have also been suspected of contributing to high cesarean section rates. Before the implementation of NHI, Taiwan's health care system had 3 types of social health insurance: government insurance, labor insurance, and farmer insurance. These plans covered approximately 60 percent of Taiwan's population; 40 percent of people were left uninsured. Compared with the previous self-paying scheme for those uninsured, NHI provided a nearly zero price childbirth option. Thus, with NHI, the financial differential between cesarean section and vaginal delivery disappeared. When there is no clinical need for cesarean section, the cost differential for selecting surgical delivery is NT\$15000 (US\$1 = NT\$32). Many families are willing to bear this cost difference. In 2001, approximately 3.5 percent of deliveries, 7.6 percent of all cesarean sections, were cesarean sections performed without clinical need (14). These figures match Norway's 7.6 percent (15) and are eclipsed by Italy's 9 percent (16). Therefore, another objective of this study was to examine whether the demand for cesarean section increased after implementation of NHI.

Methods

Analysis for all Cesarean Sections in the Pre- and Post-NHI Period

Data used in this study were drawn from the 1989 and 1996 National Maternal and Infant Health Survey in Taiwan. The survey provides a national representative data set, which includes all women who gave birth between May 15 and 17, 1989, and between February 12 and 16, 1996, with gestational outcomes occurring at 20 weeks' or more gestation. Data were collected in 2 stages. In the first stage, each county and city health bureau issued a birth event recording form to all medical facilities. This form was used to record all gestational outcomes occurring at 20 weeks' or more

gestation. In the second stage, public health nurses conducted a face-to-face survey of women for all cases where forms were completed satisfactorily. From the 1,926 and 3,998 reported birth events (1989 and 1996, respectively), interviews were held with 86.3 percent (1,662) and 90.7 percent (3,626) of women. The final data set of surveys with full information includes 1,610 and 3,546 reports. This data set is the best available for examining the impact of NHI on maternal and child health care.

The logistic regression models were formulated. We used the pre-NHI and post-NHI model to compare changes in the relationships between fetal gender and choice for cesarean section. By pooling the 2 data sets and including the NHI dummy variable in the second model, we were able to investigate whether or not the implementation of NHI influenced the mother's decision to have cesarean sections. To obtain an accurate estimate of parameters, other factors known to influence the mode of delivery, such as clinical indications, maternal characteristics, and demographic factors were controlled.

NHI Research Database Analysis for Parent-Requested Cesarean Section

In the National Maternal and Infant Health Survey, no information was included on how the choice for cesarean section was made. As an alternative, we used another study sample comprising all women giving birth in Taiwan in 2001 to 2003, with the data being created by linking birth certificate data and NHI Research Databases. This procedure was done to confine our analysis to parent-requested cesarean section. The NHI Research Database covers all medical claims, which are reimbursed based on the diagnosis-related group classification code of NHI. Medically necessary cesarean delivery is coded differently from cesarean delivery performed at parental request. The first is reimbursed at twice the vaginal delivery rate, the second is reimbursed at the same rate, with patients paying the difference. We only included women with single instances of vaginal delivery and parent-requested cesarean section. This method limits our study to the impact of fetus gender on a parent's request for cesarean delivery without medical indication. We excluded medically necessary cesarean deliveries.

Although the NHI Research Database included information about whether women choose cesarean section without clinical necessity, it lacked crucial demographic data, including neonatal characteristics (gender, birthweight, and gestational age) and maternal characteristics (age, education level, and marital status). To compensate for this lack of information,

we linked the NHI Research Database with birth certificate data, which provided the necessary remaining information. Logistic regression was performed separately for the 2001, 2002, and 2003 linkage data sets. Crude and adjusted odds ratio (OR) were estimated. The potential confounders controlled for in the multivariate logistic regression analyses were maternal age, parity, multiple gestation, marital status, gender, gestational age, and birthweight.

Results

Survey Data Analysis

Table 1 shows the number of cesarean sections performed and characterizes the mothers and newborns before and after NHI was introduced. The percentage of pregnant women who received cesarean sections increased by 6.3 percent after NHI, from 24.2 to 30.5 percent. As expected, regardless of whether NHI was in place or not, male newborns were more likely to be delivered by cesarean section than females (25.5 vs 22.6% before NHI; 31.8 vs 29.0% after NHI). Both before and after NHI, firstborn babies were more frequently delivered by cesarean section than nonfirstborn (27.8 vs 21.9% before NHI; 31.4 vs 29.8% after NHI). A much greater percentage of multiple-birth newborns were delivered by cesarean section than those born alone in both periods (80.0 vs 23.5% before NHI; 83.3 vs 29.0% after NHI). Although little difference was noted between birthweight and cesarean section before NHI (23.7 vs 24.6%), afterward, those newborns weighing more than average were more likely to be delivered by cesarean section than those with average or lower weight (32.4 vs 28.8%). Moreover, women who delivered their babies at hospitals were much more likely to undergo cesarean section than those who delivered their babies in clinics both before (30.5 vs 17.9%) and after NHI implementation (33.8 vs 26.7%), although cesarean deliveries in clinics increased notably after NHI.

Women aged 35 years and over had the highest percentage of cesarean sections (40%), both before and after NHI, and older mothers had a higher percentage of cesarean sections compared with younger mothers. Married women were less likely than the unmarried women to have cesarean sections in both pre- and post-NHI periods (28.4 vs 33.5%). Women with senior high school educations or above were more likely to have cesarean sections than those with a junior high school education or below. Women who had previous cesarean sections or gained more than an average amount of weight both increased with

Table 1. Characteristics of the Sample from the 1989 and 1996 Survey Data, Cesarean Section Choice

Characteristic	Pre-NHI (1989)		Post-NHI (1996)		Pooling (1989 and 1996)	
	Total Sample No. (%)	Cesarean Section Choice No. (%)	Total Sample No. (%)	Cesarean Section Choice No. (%)	Total Sample No. (%)	Cesarean Section Choice No. (%)
Variable	1,610 (100.0)	389 (24.1)	3,546 (100.0)	1,082 (30.5)	5,156 (100.0)	1,471 (28.5)
Fetal characteristics						
Gender						
Boy	871 (54.1)	222 (25.4)	1,878 (52.9)	598 (31.8)	2,749 (53.3)	820 (29.8)
Girl	739 (45.9)	167 (22.6)	1,668 (47.0)	484 (29.0)	2,407 (46.6)	651 (27.0)
First order						
Yes	616 (38.2)	171 (27.7)	1,592 (44.9)	500 (31.4)	2,208 (42.8)	671 (30.3)
No	994 (61.7)	218 (21.9)	1,954 (55.1)	582 (29.7)	2,948 (57.1)	800 (27.1)
Multiple birth						
Yes	20 (1.2)	16 (80.0)	96 (2.7)	80 (83.3)	116 (2.2)	96 (82.7)
No	1,590 (98.7)	373 (23.4)	3,450 (97.2)	1,002 (29.0)	5,040 (97.7)	1,375 (27.2)
Birthweight over average (3,210 g)						
Yes	834 (51.8)	198 (23.7)	1,664 (46.9)	540 (32.4)	2,498 (48.4)	738 (29.5)
No	776 (48.2)	191 (24.6)	1,882 (53.0)	542 (28.8)	2,658 (51.5)	733 (27.5)
Hospital delivery						
Yes	799 (49.6)	244 (30.5)	1,929 (54.4)	651 (33.7)	2,728 (52.9)	895 (32.8)
No	811 (50.3)	145 (17.8)	1,617 (45.6)	431 (26.6)	2,428 (47.0)	576 (23.7)
Maternal characteristics						
Maternal age (yr)						
< 25	483 (30.0)	96 (19.8)	819 (23.1)	190 (23.2)	1,302 (25.2)	286 (21.9)
25–29	737 (45.7)	181 (24.5)	1,450 (40.8)	439 (30.2)	2,187 (42.4)	620 (28.3)
30–34	325 (20.1)	86 (26.4)	1,005 (28.3)	342 (34.0)	1,330 (25.8)	428 (32.1)
≥ 35	65 (4.0)	26 (40.0)	272 (7.6)	111 (40.8)	337 (6.5)	137 (40.6)
Marital status						
Married	1,571 (97.5)	374 (23.8)	3,427 (96.6)	1,044 (30.4)	4,998 (96.9)	1,418 (28.3)
Unmarried	39 (2.4)	15 (38.4)	119 (3.3)	38 (31.9)	158 (3.0)	53 (33.5)
Maternal education						
Primary school and below	240 (14.9)	67 (27.9)	163 (4.6)	46 (28.2)	403 (7.8)	113 (28.0)
Junior high school	446 (27.7)	86 (19.2)	661 (18.6)	178 (26.9)	1,107 (21.4)	264 (23.8)
Senior high school	670 (41.6)	161 (24.0)	1,808 (50.9)	547 (30.2)	2,478 (48.0)	708 (28.5)
College and above	254 (15.7)	75 (29.5)	914 (25.7)	311 (34.0)	1,168 (22.6)	386 (33.0)
Maternal employment status						
Housewife	990 (61.4)	239 (24.1)	1,410 (39.7)	419 (29.7)	2,400 (46.5)	658 (27.4)
Employed	620 (38.5)	150 (24.1)	2,136 (60.2)	663 (31.0)	2,756 (53.4)	813 (29.5)
Obstetric characteristics						
Past pregnancy complications						
Yes	345 (30.8)	109 (31.5)	775 (69.2)	267 (34.4)	1,120 (21.7)	376 (33.5)
No	1,265 (78.5)	280 (22.1)	2,771 (78.1)	815 (29.4)	4,036 (78.2)	1,095 (27.1)
Stillbirth experience						
Yes	27 (32.1)	9 (33.3)	57 (67.8)	29 (50.8)	84 (1.6)	38 (45.2)
No	1,583 (98.3)	380 (24.0)	3,489 (98.3)	1,053 (30.1)	5,072 (98.3)	1,433 (28.2)
Previous cesarean section						
Yes	156 (9.6)	126 (80.7)	494 (13.9)	419 (84.8)	650 (12.6)	545 (83.8)
No	1,454 (90.3)	263 (18.0)	3,052 (86.0)	663 (21.7)	4,506 (87.3)	926 (20.5)
Breech presentation						
Yes	197 (12.2)	121 (61.4)	436 (68.8)	286 (65.6)	633 (12.2)	407 (64.3)
No	1,413 (87.7)	268 (18.9)	3,110 (87.7)	796 (25.5)	4,523 (87.7)	1,064 (23.5)
Maternal weight gain over average (14.26 kg)						
Yes	621 (38.5)	185 (29.7)	1,693 (47.7)	576 (34.0)	2,314 (44.8)	761 (32.8)
No	989 (61.4)	204 (20.6)	1,853 (52.2)	506 (27.3)	2,842 (55.1)	710 (24.9)
Regional characteristics						
North area	670 (41.6)	186 (27.7)	1,629 (45.9)	544 (33.3)	2,299 (44.5)	730 (31.7)
Central area	446 (27.7)	93 (20.8)	872 (24.5)	225 (25.8)	1,318 (25.5)	318 (24.1)
Southern area	382 (23.7)	78 (20.4)	769 (21.6)	226 (29.3)	1,151 (22.3)	304 (26.4)
Eastern area	112 (6.9)	32 (28.5)	276 (7.7)	87 (31.5)	388 (7.5)	119 (30.6)

NHI = National Health Insurance.

implementation of NHI (9.7 and 38.6% before NHI, 13.9 and 47.7% after NHI).

No changes were observed in 2 obstetric characteristics before and after NHI. First, the percentage of pregnant women who had experienced complications in a previous pregnancy was statistically identical (21.4 before vs 21.9% after). Second, those with breech presentations in the current pregnancy remained almost identical (12.2 before vs 12.3% after). Geographically, northern Taiwan, the most developed and populated area, was most represented in the sample (42–46% of cases). The eastern area was least represented. In general, women in the northern areas were more likely than those in the 3 other areas to have cesarean sections (32 vs 24%, 26%, 31%).

Table 2 shows the factors associated with deciding to have a cesarean section before and after NHI was implemented. Three regressions were run: the pre-NHI, the post-NHI, and the pooling regression.

In the pre-NHI and post-NHI model, we compared the determinants of deciding to have cesarean sections before and after NHI implementation. Approximately two thirds of the variables were found to be significantly associated with the probability of receiving cesarean sections before and after NHI. Carrying a male baby was found by all 3 models to have a significant and positive coefficient, supporting our hypothesis that women pregnant with baby boys were more likely than those with baby girls to have cesarean sections. Pre- and post-NHI OR indicated that women expecting baby boys were 1.37 and 1.19 times more likely than those expecting girls to have cesarean sections. In the pooling model, the coefficient of male was also shown to be highly significant ($p = 0.005$) with an OR of 1.248, a finding that also supported our hypothesis. Surprisingly, however, the coefficient of NHI was positive but insignificant, indicating that the implementation of NHI did not affect the demand for cesarean sections.

Table 2. Logistic Regression Analyses of Cesarean Section—Pre-NHI, Post-NHI, and Pooling Samples

<i>Characteristic</i>	<i>Pre-NHI (1989) OR</i>	<i>Post-NHI (1996) OR</i>	<i>Pooling (1989 and 1996) OR</i>
Fetal characteristics			
Boy	1.37†	1.19‡	1.25*
First order	4.34*	4.58*	4.48*
Multiple birth	4.01†	19.03*	14.41*
Birthweight over average (3,210 g)	1.14	1.48*	1.37*
Hospital delivery	1.64*	1.08	1.20†
NHI			1.05
Maternal characteristics			
Maternal age (yr)			
25–29	1.54†	1.43*	1.46*
30–34	1.64†	1.50*	1.54*
≥ 35 (< 25 is reference group)	3.25*	2.55*	2.68*
Marital status			
Married	0.52	1.43	0.67‡
Maternal education			
Junior high school	0.66‡	1.50	0.80
Senior high school	0.66‡	2.55	0.85
College and above (primary school and below are reference group)	0.71	0.98	0.80
Maternal employment status			
Housewife	1.42†	0.99	1.08
Obstetric characteristics			
Past pregnancy complications	1.60*	1.14	1.26†
Stillbirth experience	2.18	2.67*	2.59*
Previous cesarean section	51.35*	61.37*	57.65*
Breech presentation	9.21*	7.40*	7.85*
Maternal weight gain over average (14.26 kg)	1.55*	1.28†	1.35*
Regional characteristics			
Central area	0.77	0.75†	0.77*
Southern area	0.91	0.92	0.90
Eastern area (north area is reference group)	0.99	0.99	1.01
Number of observations	1,610	3,546	5,156

* $p < 0.01$; † $p < 0.05$; ‡ $p < 0.1$.

NHI = National Health Insurance.

The factors that other studies found to be most crucial were also significant in this study. Fetal, maternal, and obstetric characteristics were significantly and positively correlated with the decision to have cesarean sections. Babies who were firstborn, who were born with other siblings, whose birthweight was above average, or who were born in hospitals had a higher probability of being delivered by cesarean section. Pregnant women who were older, who had gained excessive weight, who had experienced complications with previous pregnancies, or who previously had experience with stillbirth, cesarean section, or breech presentation were more likely to request cesarean sections.

NHI Research Database Analysis

Characteristics of the samples are presented in Table 3. We compared the overall distribution of parent-requested cesarean section rates by gender from 2001 to 2003. Baby boys and baby girls accounted for 52 and 48 percent, respectively. The incidence of parent-requested cesarean deliveries for baby boys

was 0.3 percent higher than that for baby girls for each year. The range for baby boys was 3.5 to 3.9 and for girls 3.2 to 3.6. Approximately one half of the samples were first order. First-order babies were twice as likely to have parent-requested cesarean delivery as non-first order babies. Only 0.9% of the sample had a multiple birth. However, multiple-birth babies were more likely to have cesarean section requested by their parents than single-birth babies (6.8 vs 3.6%). Over 40% of infant birthweights were more than 3,210 g. The parents of those babies whose birthweights were over 3,210 g were more likely to request cesarean delivery than those whose babies were below 3,210 g. Almost 93 percent of the sample had a gestational age over 37 weeks, but little difference was observed in the decision for parent-requested cesarean delivery. Among the 4 maternal age groups, more than two thirds of the pregnant women were within the range of 30 to 34 years, and the remaining groups constituted 30 percent. Compared with the youngest pregnant women, those aged 25 to 29, 30 to 34, and above 35 years more frequently requested cesarean delivery (2.4 vs 3.2%, 3.7%, 6.1%, respectively). Most women

Table 3. Characteristics of the Samples from NHI Research Database from 2001 to 2003

Characteristic	2001		2002		2003	
	Total Sample No. (%)	Parent-Requested Cesarean Delivery No. (%)	Total Sample No. (%)	Parent-Requested Cesarean Delivery No. (%)	Total Sample No. (%)	Parent-Requested Cesarean Delivery No. (%)
Variable	149,774 (100.0)	5,369 (3.5)	139,801 (100.0)	5,281 (3.7)	118,475 (100.0)	3,999 (3.3)
Fetal characteristics						
Boy						
Yes	77,358 (51.7)	2,890 (3.7)	72,523 (51.8)	2,842 (3.9)	61,756 (52.1)	2,195 (3.5)
No	72,416 (48.3)	2,479 (3.4)	67,278 (48.1)	2,439 (3.6)	56,719 (47.8)	1,804 (3.1)
First order						
Yes	73,583 (49.1)	3,718 (5.0)	68,893 (49.2)	3,684 (5.3)	59,946 (50.6)	2,762 (4.6)
No	76,191 (50.8)	1,651 (2.1)	70,908 (50.7)	1,597 (2.2)	58,529 (49.4)	1,237 (2.1)
Multiple birth						
Yes	1,336 (0.8)	69 (5.1)	1,252 (0.9)	91 (7.2)	1,053 (0.8)	83 (7.8)
No	148,438 (99.1)	5,300 (3.5)	138,549 (99.1)	5,190 (3.7)	117,422 (99.1)	3,916 (3.3)
Birthweight over average (3,210 g)						
Yes	60,585 (40.4)	2,300 (3.8)	55,681 (39.8)	2,254 (4.0)	47,283 (39.9)	1,733 (3.6)
No	89,189 (59.5)	3,069 (3.4)	84,120 (60.1)	3,027 (3.6)	71,192 (60.0)	2,266 (3.1)
Gestational age (> 37 wk)						
Yes	139,783 (93.3)	5,002 (3.5)	130,397 (93.2)	4,915 (3.7)	110,440 (93.2)	3,743 (3.3)
No	9,991 (6.6)	367 (3.6)	9,404 (6.7)	366 (3.8)	8,035 (6.7)	256 (3.1)
Maternal characteristics						
Maternal age (yr)						
< 25	21,020 (14.0)	493 (2.3)	24,978 (17.8)	649 (2.6)	24,864 (20.9)	549 (2.2)
25–29	49,111 (32.7)	1,559 (3.1)	50,910 (36.4)	1,760 (3.4)	46,978 (39.6)	1,417 (3.0)
30–34	54,155 (36.1)	1,924 (3.5)	46,526 (33.2)	1,762 (3.7)	35,669 (30.1)	1,333 (3.7)
≥ 35	25,488 (17.0)	1,393 (5.4)	17,387 (12.4)	1,110 (6.3)	10,964 (9.2)	700 (6.3)
Marital status						
Married	144,161 (96.2)	5,108 (3.5)	134,718 (96.3)	5,013 (3.7)	117,930 (99.5)	3,967 (3.3)
Unmarried	5,613 (3.7)	260 (4.6)	5,083 (3.6)	268 (5.2)	545 (0.4)	32 (5.8)

NHI = National Health Insurance.

were married (97%). Married women had fewer parent-requested cesarean deliveries than their counterparts (3.5 vs 5.3%).

As can be seen in Table 4, the crude OR of parent-requested cesarean delivery was significantly increased for baby boys (OR = 1.10 in 2001, 1.08 in 2002, and 1.12 in 2003). After adjustment for potential confounders (maternal age, parity, multiple gestation, marital status, gender, gestational age, and birthweight), the OR slightly increased to 1.10 in 2002 and to 1.13 in 2003. No change was found in 2001 (Table 5). Among 6 potential confounders, only gestational age was not found to be significant, whereas the other 5, as expected, were found to have statistically strong and significant impacts ($p < 0.001$) on the decision of parent-requested cesarean delivery.

Discussion

Taiwan has one of the world's highest cesarean section rates, competing with most Latin American countries, where the rates are also high. Although Taiwan has tried to lower the cesarean section rate, no significant decline has occurred in the past decade. The reasons for the lack of change could lie in Taiwan's cultural beliefs combined with the characteristics of mothers and babies. This study is the first to begin to gather empirical information on this question. We assessed how gender of the fetus (preferences for sons) influences the decision to have a cesarean section and examined whether Taiwan's NHI system implemented in 1995 brought about changes in demand for the procedure. The hypothesis for this study is based on speculation that demand for cesarean section may be more related to the desire for sons to be born on a lucky day than on issues of possible complications in labor.

To date, no data set has been specifically designed to provide the data needed for this study. We used survey data and claimed data for different purposes. The survey data, which included the sample both in the pre- and post-NHI period, allowed us to examine the impact of NHI on cesarean section choice. How-

Table 4. Crude Odds of Parent-Requested Cesarean Delivery by Newborn Gender—2001, 2002, and 2003

Variable	2001 OR (95% CI)	2002 OR (95% CI)	2003 OR (95% CI)
Boy	1.10† (1.04–1.16)	1.08‡ (1.03–1.15)	1.12* (1.05–1.20)

* $p < 0.001$; † $p < 0.01$; ‡ $p < 0.05$.

ever, it did not identify whether cesarean section was parent requested. The linkage data combining birth certificate with NHI research claimed data allowed us to evaluate the genuine impact of fetal gender on parent-requested cesarean section. The results supported our hypothesis: the decision to have a cesarean section was related to the gender of the fetus.

However, although statistically significant, the actual 0.3 percent gender difference is small and poses no significant public health impact. For this reason, our study does not provide strong evidence that gender-based education would have a noticeable impact on the goal of reducing cesarean section rates in Taiwan. It is unlikely that public education focusing on gender difference will change the rates.

Surprisingly, the availability to NHI was not found to affect the demand for cesarean sections. This finding was not consistent with that from Shanghai, China (17). In Shanghai, which is racially comparable with Taiwan, the high cesarean section rate increased with the introduction of health insurance. This discrepancy may reflect a stronger economy in Taiwan, where price did not affect the choice. Latin American countries showed trends similar to those in Shanghai. Insurance schemes in Latin America increased the demand for cesarean sections. In Chile and Brazil, for example, private health insurance has been associated with higher demand for cesarean sections (18–21). To reduce the number of unnecessary cesarean sections there, insurance schemes in Chile are not allowed to pay obstetricians more for cesarean sections than for vaginal deliveries (19). Therefore, policy makers should be aware that Taiwan's high cesarean section rate is not affected by financial concerns. Attempting reform policy through financial incentives

Table 5. Adjusted Odds of Parent-Requested Cesarean Delivery—2001, 2002, and 2003

Characteristic	2001 OR	2002 OR	2003 OR
Fetal characteristics			
Boy	1.10†	1.09†	1.12*
First order	3.02*	3.02*	2.81*
Multiple birth	1.35‡	1.96*	2.46*
Birthweight over average (3,210 g)	1.13*	1.15*	1.16*
Gestational age (> 37 wk)	0.96	0.99	1.13
Maternal age (yr)			
25–29	0.63*	1.65*	0.67*
30–34	1.23*	1.26*	1.43*
≥ 35 (below 25 is reference group)	2.43*	2.55*	2.96*
Marital status			
Married	0.74*	0.68*	0.55*

* $p < 0.001$; † $p < 0.01$; ‡ $p < 0.05$.

is likely to have only a limited effect, or no effect, on demand for cesarean sections.

It is noteworthy that since the 1989 and 1996 comparisons included all cesarean sections (parental choice without medical indications and parental "choice" with medical indications), NHI could have affected either or both of these choices and changes in either or both would affect the overall cesarean section rate. In fact, the cesarean section rate did go up between the 2 samples, from 24.2 percent in 1989 to 30.5 percent in 1996 (a relative increase of 26%). However, when we controlled other characteristics, NHI alone was not found to be a significant contributor. This finding was, surprisingly, different from the studies indicated above. The possible reason was that these studies did not control for the other factors. Therefore, health policy makers should be aware that similar results could be derived after controlling potential factors in the estimation of those studies.

NHI and fetal gender, therefore, are weakly associated with cesarean section. Reported factors that were strongly associated turned out to be obstetric characteristics, and included complications with past pregnancy, stillbirth experience, previous cesarean section, breech presentation, and maternal weight gain higher than average. In particular, pregnant women with previous cesarean sections were 58 times more likely to choose cesarean section than their counterparts.

These trends stand in contrast with evidence from a meta-analysis of morbidity and mortality associated with vaginal birth after cesarean (VBAC). VBAC has been demonstrated to be a safe alternative to repeat cesarean section. It appears that the belief "once a cesarean, always a cesarean," now known to be invalid, may be the critical area for education. VBAC can be appropriately used with specialist backup (2,22).

Conclusions

To reduce the rate of cesarean section effectively, Taiwan's health authorities should actively work to encourage women to attempt VBAC and to educate the general population about the risks associated with cesarean section. These interventions may do more than financial interventions to narrow the gap between vaginal delivery and delivery by cesarean section.

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