Delayed Parenthood and the Risk of Cesarean Delivery—Is Paternal Age an Independent Risk Factor?

Chao-Hsiun Tang, PhD, Ming-Ping Wu, MD, Jin-Tan Liu, PhD, Herng-Ching Lin, PhD, and Chun-Chyang Hsu, MPH

ABSTRACT: Background: *Between 1995 and 2001, the average cesarean section rates in Taiwan were as high as 33.34 percent. This study set out to determine the independent effects of paternal age on the likelihood of cesarean delivery among a sample of Taiwanese women.* **Methods:** *Logistic regressions were used to analyze 310,574 singleton deliveries by nulliparous women in Taiwan between 1999 and 2001, linking data abstracted from birth certificates and from the National Health Insurance claims database. After controlling for socioeconomic, pregnancy, and obstetric complications, as well as institutional factors, we investigated both maternal and paternal ages simultaneously, using the single category variable "parental age" to determine the differential age effects on the risk of cesarean delivery.* **Results:** *Taking 20- to 29-year-old couples as the reference group, we observed that the relative risks of cesarean delivery become progressively higher with advancing age of the mother. At the same time, within each maternal group, positive and significant variations in cesarean rates occurred for different paternal age groups. The respective increases in the relative risks of cesarean delivery for men aged 20–29, 30–34, 35–39, and 40 years or more, in conjunction with women aged 20–29, 30–34 and 35 or over, are 34 percent from 1.00 to 1.34, 18 percent from 1.51 to 1.69, and 16 percent from 2.03 to 2.19. Other confounding variables are also taken into account.* **Conclusions:** *Irrespective of maternal age, advancing paternal age also appears to be an additional independent factor that has a strong association with the increase in cesarean section rates. (BIRTH 33:1 March 2006)*

Along with the rapid economic development that has occurred within the developing world over recent decades, resultant changes in social structures have led to a dramatic decline in birth rates and a general shift in planned parenthood at a much later age. Although the association between later parenthood and the increase in cesarean section rates has already been widely reported, such studies have tended to focus solely on an investigation into the effects of maternal age (1–6); however, it has yet to be determined whether any independent relationship exists between the risk of cesarean section and paternal age. Considerable potential exists for paternal age to confound maternal age effects.

The growing proportion of men and women in developing countries who start families late in life has had an increasingly significant impact on cesarean section rates. For example, from 1991 to 2001 the age-specific birth

Chao-Hsiun Tang and Herng-Ching Lin are Associate Professors at the School of Health Care Administration, Taipei Medical University; Ming-Ping Wu is an Assistant Professor at the Department of Obstetrics and Gynecology, Chi Mei Foundation Hospital and College of Medicine, Taipei Medical University; Jin-Tan Liu is a Professor at the Department of Economics, National Taiwan University; and Chun-Chyang Hsu is the Deputy Commissioner of the Department of Health, Taipei City Government, Taiwan.

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Address correspondence to Chun-Chyang Hsu, MPH, Department of Health, Taipei City Government, 1 Shih-Fu Road, Taipei, Taiwan 110.

rates in Taiwan rose from 16.4 to 20.3 per 1,000 for women aged between 35 and 39 years, and from 2.1 to 2.7 per 1,000 for women aged between 40 and 44 years. This factor has coincided with even greater increases in the age-specific rates for men; over the same period, the rates increased from 43.0 to 50.9 per 1,000 for men aged between 35 and 39 years, from 11.0 to 16.1 for men aged between 40 and 44 years, and from 3.0 to 4.2 for men aged between 45 and 49 years (7).

In tandem with this rise in age-specific birth rates, cesarean section rates have also reached historically high levels in Taiwan over recent years, fluctuating between 32.67 percent and 34.47 percent from 1995 to 2001, with an average rate of 33.34 percent (8), which is more than twice the optimal rate suggested by the World Health Organization (9). Cesarean deliveries have become the most common of all major surgical procedures now being undertaken within the National Health Insurance (NHI) program in Taiwan, filling countless operating rooms and beds, and consuming copious amounts of valuable healthcare resources. In 2000, hospitalizations resulting from cesarean section operations were in the top 20 percent of all NHI expense consumers, accounting for 2.3 percent of the NHI's total in-patient costs (10).

The aim of this study was to address the independent risks of cesarean delivery stemming from the rise in both maternal and paternal age. When examining the effects of delayed parenthood on cesarean delivery, the conclusions drawn from the results of population-based studies can be extrapolated and generalized (1,6), whereas findings based on a sampling frame will be limited to the specific study population (2–5). Studies should also include factors that may potentially confound the relationship between age and cesarean section rates, such as socioeconomic variables, pregnancy indications, and obstetric outcomes. Nevertheless, although several population-based studies have already been undertaken, the amount of information contained within these studies on such confounding factors has tended to be rather limited. By linking data drawn from Taiwanese birth certificates and population-based NHI claims data, this study demonstrates that within an NHI setting, wherein financial barriers to medical care have mostly been eliminated, both advancing paternal age and maternal age have contributed to the higher cesarean section rates.

Methods

Data Collection

This study takes as its sample 726,979 live births that occurred in hospitals and clinics in Taiwan that were reimbursed by the National Health Insurance between 1999 and 2001, linking data abstracted from birth certificates and from the National Health Insurance claims database. The mother's date of birth and her unique personal identification number provide the link between the birth certificate data and the database. A total of 152 deliveries, representing 0.02 percent of the total sample, had missing data on the father's age. After excluding all cases with such missing values, women with multiple gestations, and those less than age 20 years, the remaining dataset comprised a total of 310,574 single births delivered by nulliparous women. The birth certificate dataset contained variables indicating maternal and paternal age and education, infant birthweight, sex, gestation period (in weeks), and the mother's gravidity, marital status, and county of residence. The NHI claims database contains the following information on all deliveries occurring in NHI-contracting hospitals and clinics: (a) the method of delivery; (b) the ownership and teaching status of the hospital/clinic; and (c) one principal and four secondary ICD-9-CM diagnosis codes.

Variable Definitions

The method of delivery, cesarean or vaginal, was taken as the dependent variable. Within the analysis the independent variables were categorized as follows: (a) parental age; (b) maternal education; (c) paternal education; (d) mother's marital status, parity, pregnancy, and labor complications; (e) infant's sex, birthweight, and period of gestation in weeks; and (e) hospital characteristics.

Parental ages were defined as each parent's age, in years, at the time of the infant's birth, whereas maternal and paternal education were based on the total years of formal education and categorized into five levels, in accordance with the school system in Taiwan. Labor and pregnancy complications at the time of labor and delivery were classified in accordance with the International Classification of Diseases, Ninth Revision (ICD-9), and were included in accordance with the obstetric and pregnancy predictors considered in previous studies (ICD codes are in parentheses) (1–4). Labor complications included breech presentation (652.[1,2], 660.0, 761.7, 763.0), other malpresentation (652.[3, 4, 6–9], 763.1), and fetal distress (656.3., 768.[1–4]). Pregnancy complications at the time of delivery were defined as hypertension (642.[0–3, 9], 760.0), preeclampsia or eclampsia (642.[4–7], 586.0, 780.3), gestational or mellitus diabetes (648.[0, 8], 775.0), and placental abnormality (previa: 641.[0, 1], 762.0, or abruption: 641.2, 762.1).

Since a significant correlation exists between maternal and paternal ages (r = 0.72, $p < 0.0001$), our analysis of the maternal and paternal ages within the same multivariate model posed potential problems of collinearity. To deal with such potential problems, a variable "parental age" was created, thus combining the 3 maternal age groups, each of which contained the 4 paternal age groups. A total of 12 classes were defined for this variable, thereby enabling this study to analyze both maternal and paternal ages simultaneously. Both men and women between ages 20 and 29 years were taken as the reference group when performing the regression analysis. For those parents age 30 years or older, the data were stratified into 5-year age groups.

Statistical Analysis

Multiple logistic regression analyses were conducted using PROC LOGISTIC in the SAS system for Windows (11), with the unit of analysis being an individual delivery. The odds ratios (ORs) and the 95% confidence intervals (CIs) were estimated both before and after adjusting for confounding factors. Since cesarean delivery was a common outcome, the adjusted odds ratios derived from the logistic regression could no longer approximate the relative risks. A method proposed by Zhang and Fu (12) was therefore employed to calculate the relative risks (RR) using the odds ratios obtained from logistic regressions with the lower and upper limits of the confidence interval also being corrected accordingly.

Results

The resultant dataset comprised 310,574 births by nulliparous women, of which 100,830 were reported as a cesarean delivery, giving a cesarean section rate of 32.4 percent. The profile of women sampled, according to the mode of delivery, is summarized in Table 1. Most parturients (43%) were placed in the group of 20- to 29- year-old couples. From the baseline rates of 27.1 percent for the reference group (men and women ages 20–29 yr), the cesarean section rates steadily increased with the corresponding increase in maternal age and/or paternal age.

The cesarean section rates for the 4 groups of men ages 20–29, 30–34, 35–39, and 40 years or over in conjunction with women ages 20–29 years were 27.17 to 35.77 percent; for the 4 groups of men in conjunction with women ages 30–34 years, the cesarean section rates were 39.65 to 44.42 percent; and for the same groups in conjunction with women ages 35 year or more, the cesarean section rates were 55.38 to 58.38 percent (data not shown). Irrespective of the age of the father, the cesarean section rates were consistently higher with advancing age of the mother. A substantial increase in the rate for each of the maternal age groups also occurred, however, with advancing age of the father.

Overall, the cesarean section rate in each parental group among unmarried couples was higher than the rates among married couples. For married couples, the cesarean section rates for the 4 groups of men in conjunction with women ages 20–29, 30–34, and 35 years or over were 27.10 to 35.95 percent, 39.31 to 43.97 percent, and 53.83 to 58.25 percent, respectively. For unmarried couples, the cesarean section rates for the 4 groups of men in conjunction with each maternal group were 30.16 to 34.96 percent, 44.60 to 49.16 percent, and 58.10 to 60.51 percent, respectively (data available on request from the authors). Table 1 also summarizes the education distribution for both mother and father, along with their marital status, pregnancy and obstetric complications, the infants' sex, birthweight, period of gestation in weeks, and hospital ownership and teaching status of the healthcare institution by delivery mode.

An association has been suggested among socioeconomic status, pregnancy complications, neonatal outcomes, and the major independent variables, maternal and paternal age (13–23). Table 2 illustrates the distribution of some important independent variables for each parental age group, indicating that college or higher education is more common among older parents than younger parents, whereas the incidence of unmarried parents is more common among those couples where the age difference is greater. The proportion of low birthweight, macrosomia, and preterm births was higher among older mothers and/or older fathers. Cases of breech, malpresentation, fetal distress, preeclampsia or eclampsia, abruptio placentae, placenta previa, hypertension, and diabetes were also more common among older couples.

Of all parental age groups, the highest probability of couples being unmarried, of conceiving low-birthweight, preterm, or postdated infants, or of abruptio placentae or fetal distress, was found in those cases where the father was age 20–29 years and the mother was 35 years or older. The estimates were therefore adjusted for the effects of other variables using multiple logistic regressions, thus taking into consideration the socioeconomic factors, pregnancy and labor complication factors, and institutional factors that could potentially confound parental age effects.

Table 3 reports adjusted relationships between parental age and likelihood of a cesarean delivery, with only minor differences being found between crude and adjusted relative risks. Taking 20- to 29-year-old couples as the reference group, the adjusted rela-

Table 1. Profiles of Nulliparous Women Delivering in Taiwan, 1999–2001 (n = 310,574)

		Cesarean Delivery		*Vaginal Delivery*	
Variables		*No. of Births*	*(%)*	*No. of Births*	*(%)*
Delivery mode		100,830	(100)	209,744	(100)
Maternal age (yr)	Paternal age (yr)				
20–29	20–29	36,590	(36.29)	98,104	(46.78)
20–29	30–34	20,880	(20.71)	49,210	(23.46)
20–29	35–39	3,784	(3.75)	8,250	(3.93)
20–29	≥40	704	(0.70)	1,264	(0.60)
30–34	20–29	2,738	(2.72)	4,168	(1.99)
30–34	30–34	16,549	(16.41)	26,998	(12.87)
30–34	35–39	8,045	(7.98)	11,784	(5.62)
30–34	≥40	1,533	(1.52)	1,918	(0.91)
≥35	20–29	386	(0.38)	311	(0.15)
≥35	30–34	1,754	(1.74)	1,452	(0.69)
≥35	35–39	4,618	(4.58)	3,971	(1.89)
≥35	≥40	3,246	(3.22)	2,314	(1.10)
Paternal education					
Elementary school		2,007	(1.99)	3,574	(1.70)
Junior high school		19,696	(19.53)	38,926	(18.56)
Senior high school		40,384	(40.05)	84,045	(40.07)
College		21,374	(21.20)	46,311	(22.08)
University or above		17,372	(17.23)	36,888	(17.59)
Maternal education					
Elementary school		2,617	(2.60)	4,867	(2.32)
Junior high school		17,133	(16.99)	33,106	(15.78)
Senior high school		45,698	(45.32)	93,780	(44.74)
College		22,098	(21.92)	49,287	(23.50)
University or above		13,284	(13.17)	28,704	(13.69)
Marital status					
Unmarried		4,083	(4.05)	6,747	(3.22)
Married		96,747	(95.95)	202,997	(96.78)
Infant's birthweight (g)					
< 2,500		7,440	(7.38)	13,145	(6.27)
2,500–4,000		89,102	(88.37)	194,042	(92.51)
> 4,000		4,288	(4.25)	2,557	(1.08)
Gestational period at birth (wk)					
< 32		785	(0.78)	993	(0.47)
33–36		2,932	(2.91)	3,957	(1.89)
37–42		96,162	(95.37)	203,568	(97.06)
> 42		951	(0.94)	1,226	(0.58)
Infant's sex					
Female		4,6971	(46.58)	103,021	(49.12)
Male		5,3859	(53.42)	106,723	(50.88)
Breech					
No		7,6436	(75.81)	209,335	(99.81)
Yes		2,4394	(24.19)	409	(0.19)
Malpresentation					
No		9,8118	(97.31)	209,637	(99.95)
Yes		2,712	(2.69)	107	(0.05)
Fetal distress					
No		89,652	(88.91)	208,501	(99.41)
Yes		11,178	(11.09)	1,243	(0.59)
Hypertension					
No		99,665	(98.84)	209,161	(99.72)
Yes		1,165	(1.16)	583	(0.28)
Preeclampsia or eclampsia					
No		97,545	(96.74)	209,072	(99.68)
Yes		3,285	(3.26)	672	(0.32)

(Continued)

tive risks for a cesarean delivery became progressively higher with the mother's advancing age. In particular, within every paternal age group, women age 35 years or more were found to have a likelihood of cesarean delivery that was more than twice as high as that of the reference group. At the same time, within each maternal group, positive and significant variations in the cesarean section rates were observed for men ages 20–29, 30–34, 35–39, and 40 years or more, with the exception of those for women who were older than their male partners. Nonetheless, women whose partners were age 40 years and above were consistently shown to be at the highest risk of cesarean delivery within each maternal age group. For those women age 20–29 years, the risk of cesarean delivery increased 34 percent when the man was age 40 years or more (RR = 1.34), compared with those cases within the same maternal age group when the man was age 20–29 years (the reference group).

For women in the age group between 30 and 34 years, the risk of cesarean delivery increased 18 percent when the man was age 40 years or more (RR = 1.69), compared with those cases within the same maternal age group where the man was age 20–29 years (RR = 1.51). For those women in the age group of 35 years or more, the risk of cesarean delivery increased 16 percent where the man was 40 years or more (RR = 2.19), when compared with those cases within the same maternal age group where the man was age 20–29 years (RR = 2.03). The overall risk of cesarean delivery was twice as high in those cases where the woman was 35 years or older and the man was 40 years or older when compared with the youngest parental group where both parents were 20–29 years of age (the reference group).

Discussion

This study adopted a population-based dataset involving 310,574 first-time singleton birth deliveries in an attempt to examine the relationship between parental age and cesarean delivery. Advancing maternal age was found to be a significant factor in raising the cesarean section rate, which is a finding common to almost all similar studies (1–6). Few studies, however, were able to separate the influences of maternal age and socioeconomic or clinical complications effectively (1,6). Although some earlier studies examined the influence of paternal age and adverse pregnancy and neonatal outcomes (13–17,21), none of them considered the paternal age effects in determining cesarean delivery.

The main strength of this study is its large size, which facilitates the effective adjustment of possible confounding factors between parental age and other medical or socioeconomic factors. In general, maternal pregnancy, obstetric complications, and neonatal outcomes are considered to be the primary potential confounding factors (5,14,16–20,22,23). The possible interaction effect between marital status and parental age might affect the influence of parental age on cesarean section rate. Nevertheless, our study found that advancing paternal age was associated with the

Table 1. Profiles of Nulliparous Women Delivering in Taiwan, 1999–2001 (n = 310,574) (cont'd)

	Cesarean Delivery		*Vaginal Delivery*	
Variables	*No. of Births*	*(%)*	*No. of Births*	*(%)*
Diabetes				
No	100,002	(99.18)	209,188	(99.73)
Yes	828	(0.82)	556	(0.27)
Placenta previa				
No	97,022	(96.22)	209,643	(99.95)
Yes	3,808	(3.78)	101	(0.05)
Abruptio placentae				
No	99,234	(98.42)	209,616	(99.94)
Yes	1,596	(1.58)	128	(0.06)
Teaching hospital				
No	52,663	(52.23)	105,729	(50.41)
Yes	48,467	(47.77)	104,015	(49.59)
Hospital ownership				
Private	59,716	(59.22)	121,228	(57.80)
Public	11,487	(11.39)	22,767	(10.85)
Not-for-profit	29,627	(29.38)	65,749	(31.35)

Table 2. Distribution of Socioeconomic Characteristics, Pregnancy Complications, Obstetric Complications, and Neonatal Outcomes by Parental Age of Nulliparous Women Delivering in Taiwan, 1999–2001* (Unit Is % Unless Otherwise Specified)

	Maternal Age Groups (yr)†											
Characteristic	*20–29*				*30–34*				*≥35*			
Paternal age (yr)	*20–29*	*30–34*	*35–39*	*≥40*	*20–29*	*30–34*	*35–39*	*≥40*	*20–29*	*30–34*	*35–39*	*≥40*
Maternal education >12 yr	6.6	13.3	12.1	8.9	20.0	27.2	24.3	18.1	13.5	19.1	20.6	19.1
Paternal education >12 yr	8.4	19.1	18.0	16.1	22.2	32.8	30.8	26.5	22.2	20.6	24.5	25.4
Unmarried	2.3	4.1	10.2	17.7	6.3	1.8	2.5	8.7	36.3	13.7	3.7	5.7
Breech	7.0	7.5	7.6	9.0	9.8	8.8	9.4	10.8	12.1	13.0	12.1	13.4
Malpresentation	0.8	0.9	0.8	1.4	1.2	1.0	1.1	1.0	1.6	1.6	1.3	1.6
Fetal distress	3.4	3.9	4.1	3.9	4.5	4.8	4.8	4.1	7.2	4.9	5.6	6.3
Preeclampsia/eclampsia	1.0	1.1	1.2	1.0	1.4	1.5	1.8	2.0	2.3	2.0	2.6	3.3
Placenta previa	0.7	1.0	1.3	1.3	1.7	1.6	1.9	2.3	3.7	2.6	3.1	3.9
Abruptio placentae	0.5	0.5	0.4	0.5	0.6	0.6	0.7	0.7	1.7	0.7	0.7	1.2
Hypertension	0.4	0.5	0.6	0.4	0.7	0.7	0.8	0.8	1.7	1.0	1.2	2.0
Diabetes	0.2	0.3	0.4	0.4	0.7	0.7	0.9	1.2	1.3	1.6	1.7	2.2
Infant birthweight (g)												
<2,500	6.8	6.4	7.0	7.9	5.8	6.0	6.6	6.8	9.6	7.9	8.1	8.0
>4,000	1.6	2.0	2.1	2.2	2.6	2.7	2.7	3.5	2.9	3.5	3.5	3.4
Gestation period (wk)												
≤32	0.5	0.5	0.6	0.4	0.5	05	0.7	1.0	1.4	1.2	0.9	1.2
33–36	2.0	2.0	2.4	2.9	2.4	2.3	2.6	2.5	4.0	3.4	3.4	3.8
>42	0.7	0.7	0.6	1.0	0.7	0.7	0.6	0.4	1.2	0.7	0.5	0.5
Total deliveries (No.)	134,697	70,090	12,034	1,968	6,906	43,547	19,829	3,451	697	3,206	8,589	5,560

**Total number of observations = 310,574; †All parental age group comparisons in this table are statistically significant ($p < 0.0001$), as demonstrated by the chi-square test.*

increase in cesarean section rates irrespective of marital status. Moreover, although maternal age has continued to constitute the major risk factor for cesarean delivery, in each of the maternal age groups, the influence of paternal age on cesarean section rates generally persisted, even after adjustments for pregnancy and obstetric indications, infant birthweight, and the period of gestation.

Although correlation between maternal and paternal age is generally high, distribution between sociodemographic factors and access to obstetric care may be uneven among couples of different ages. The results presented in Table 2 indicated that marital relationships were more common among couples of similar ages, and also that older couples were usually both better educated and better off financially. These findings are supported by the previously reported association between advancing age of men and women and increasing risk of pregnancy and obstetric complications (5,17,19,20,23), as well as the increasing proportion of preterm and low birthweight babies (16,18–20,22). Therefore, in the absence of any adjustment for these variables, the observed risks of cesarean delivery attributed to maternal and paternal age may well be overestimated. Adjustments were made in this study for both marital status and maternal and paternal education levels, with no dramatic effects being observed on the relative risks of cesarean section rates for any group. Moreover, under the National Health Insurance in Taiwan, since obstetric care is free, the probability of access to care influencing the results of our study is unlikely.

Conclusions

The study results suggest that, aside from maternal age, advancing age of the father also appears to be an additional independent factor influencing the risk of cesarean delivery, although the explanation for this finding remains elusive; it is possible that a combination of behavioral and biological pathways may exist that link advancing paternal age and cesarean deliveries. However, it is becoming increasingly clear that older fathers have an increased chance of passing on genetic defects to their children (24). Studies have reported that risks of genetic abnormalities caused by mutations within the father's sperm are associated with the father's advancing age (25–30). The association between advancing paternal age and the increase in cesarean sections may also be confounded by the adverse pregnancy outcome and neonatal outcome that result from fathering children later in life (13–17,21).

Conversely, some risks associated with paternal age may stem more from behavior than from biology. Recent studies have shown that older men, like older women, run the risk of difficulties in terms of both conception (31–34) and miscarriage (35,36). To the extent that older expectant fathers may often consider their wife's pregnancy to be much more precious and may therefore harbor greater anxieties over the uncertainties with natural spontaneous delivery than younger expectant fathers, they may tend to demonstrate a much greater readiness to resort to cesarean delivery than younger men. Thus, such deliveries would indeed be more common among older than younger paternal groups.

Table 3. Crude and Adjusted Relative Risks of Cesarean Delivery by Parental Age Group for Nulliparous Women Delivering in Taiwan, 1999–2001

		Unadjusted		*Adjusted**	
Variables		*RR*	*95% CI*	*RR*	*95% CI*
Maternal age (yr)	Paternal age (yr)				
20–29	20–29	Referent		Referent	
20–29	30–34	1.08	1.07–1.10	1.12	1.10–1.14
20–29	35–39	1.14	1.11–1.16	1.18	1.14–1.22
20–29	≥40	1.27	1.20–1.33	1.34	1.24–1.43
30–34	20–29	1.38	1.35–1.41	1.51	1.45–1.56
30–34	30–34	1.33	1.32–1.35	1.49	1.46–1.51
30–34	35–39	1.41	1.39–1.43	1.58	1.54–1.61
30–34	≥40	1.51	1.47–1.56	1.69	1.62–1.77
≥35	20–29	1.80	1.71–1.89	2.03	1.87–2.19
≥35	30–34	1.79	1.74–1.83	2.10	2.03–2.17
≥35	35–39	1.76	1.73–1.79	2.06	2.01–2.11
≥35	≥40	1.88	1.85–1.91	2.19	2.13–2.25

**Adjusted for paternal and maternal education, mother's marital status, infant birthweight, number of weeks of gestation at birth, infant's sex, pregnancy risks, and obstetric risks; RR = relative risk; CI = confidence interval.*

Furthermore, one study indicated that fathers tended to have general misconceived beliefs about obstetric interventions, and indeed, that they regard labor induction, anesthesia, and cesarean deliveries as beneficial to their wives, in terms of relieving them from the "torture of labor" (37). Older fathers may be more outspoken and accustomed to expressing their point of view than younger fathers, which also leads us to postulate that older fathers may present an increased risk of cesarean section. This factor suggests that perhaps within the shared decision-making process about cesarean delivery, parental, or even paternal, preference may hold sway.

The greater likelihood of cesarean delivery for older fathers may also be related to Chinese cultural preferences and folklore beliefs. According to Chinese astrology, the fate of people is determined by the year of their birth, the month in which they were born, and the time of day when they were born. Thus, as one study in Taiwan showed, the most popular reason for parents, and indeed grandparents, selecting cesarean section for the delivery of their child or grandchild was to select the most auspicious day and hour for the child to be born (38). A separate empirical study also reported that, aside from the "weekend effect," which results from the physician's demand for leisure, cesarean deliveries are indeed more commonly performed on auspicious days (39). Similarly, since the Year of the Dragon is considered to be a highly auspicious time for births (40), some prospective parents reportedly rushed to hospital so that the expectant mother could undergo a cesarean section to ensure that she gave birth before the end of the Dragon Year (41). In Taiwan, the likelihood of older fathers being more traditionally minded than younger fathers is very high; thus, the probability of a preference being shown for a cesarean delivery may well be higher, based on auspicious days or hours. Clearly, therefore, this factor raises concerns from a public health perspective about the need to reduce the number of unnecessary cesarean deliveries.

The findings of this study provide an insight into the potential role of men within the decision-making process on choice of delivery mode. Further studies will be necessary to investigate those factors that may help to modify a father's attitude and knowledge toward this choice. In the meantime, however, any health policy aimed at successfully reducing cesarean section rates should include both men and women as the targeted recipients of relevant healthcare information on birth delivery modes.

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References

1. Lin HC, Sheen TC, Tang CH, Kao S. Association between maternal age and the likelihood of a cesarean section: A population-based multivariate logistic regression analysis. *Acta Obstet Gynecol Sc*and 2004;83:1178–1183.
2. Gareen IF, Morgenstern H, Greenland S, Gifford DS. Explaining the association of maternal age with cesarean delivery for nulliparous and parous women. *J Clin Epidemiol* 2003;56:1100–1110.
3. Kozinszky Z, Orvos H, Zoboki T, et al. Risk factors for cesarean section of primiparous women aged over 35 years. *Acta Obstet Gynecol Sc*and 2002;81:313–316.
4. Ecker JL, Chen KT, Cohen AP, et al. Increased risk of cesarean delivery with advancing maternal age: Indications and associated factors in nulliparous women. *Am J Obstet Gynecol* 2001;185:883–887.
5. Dulitzki M, Soriano D, Schiff E, et al. Effects of very advanced maternal age on pregnancy outcome and rate of cesarean delivery. *Obstet Gynecol* 1998;92:935–939.
6. Cnattingius R, Cnattingius S, Notzon FC. Obstacles to reducing cesarean rates in a low-cesarean setting: The effect of maternal age, height and weight. *Obstet Gynecol* 1998;92:501–506.
7. Ministry of the Interior. *2002 Taiwan-Fuchien Demographic Fact Book, Republic of China*. Taipei, Taiwan: Author, 2002.
8. Department of Health. *Health and National Health Insurance Annual Statistics Information Services, 2004/04/19*. Access at: http://www.doh.gov.tw/statistic/index.htm.
9. World Health Organization. Appropriate technology for birth. *Lancet* 1985;2:436–437.
10. Bureau of National Health Insurance. Where has all the NHI expenditure gone? Obstetrical care in the NHI program. *BNHI Newsletter on 01/28/2002*. Access at: http://www.nhi.gov.tw/information/news_detail.asp?menu = 1&menu_id = &News_ID = 336.
11. SAS Institute Inc. *SAS Software Version 8.2 of the System for Windows*. Cary, NC: Taipei Medical University, 2004.
12. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA* 1998;280:1690–1691.
13. Salihu HM, Aliyu MH, Alexander GR. The relationship between paternal age and early mortality of triplets in the United States. *Am J Perinatol* 2004;21:99–107.
14. Tough SC, Faber AJ, Svenson LW, Johnston DW. Is paternal age associated with an increased risk of low birth weight, pre-term delivery and multiple births? *Can J Public Health* 2003;94:88–92.
15. Wunsch G, Gourbin C. Parents' age at birth of their offspring and child survival. *Soc Biol* 2002;49:174–184.
16. Abel EL, Kruger M, Burd L. Effects of maternal and paternal age on Caucasian and Native American pre-term births and birth weights. *Am J Perinatol* 2002;19:49–54.
17. Harlap S, Paltiel O, Deutsch L, et al. Paternal age and pre-eclampsia. *Epidemiology* 2002;13:660–667.
18. Astolfi P, Zonta LA. Risks of pre-term delivery and association with maternal age, birth order and fetal gender. *Hum Reprod* 1999;14:2891–2894.

19. Dollberg S, Seidman DS, Armon Y, et al. Adverse perinatal outcome in the older primipara. *J Perinatol* 1996;16:93–97.
20. Prysak M, Lorenz RP, Kisly A. Pregnancy outcome in nulliparous women 35 years and older. *Obstet Gynecol* 1995;85:65–70.
21. McIntosh GC, Olshan AF, Baird PA. Paternal age and the risk of birth defects in offspring. *Epidemiology* 1995;6:282–288.
22. Cnattingius S, Forman MR, Berendes HW, Isotalo L. Delayed childbearing and risk of adverse perinatal outcome. *JAMA* 1992;268:886–890.
23. Wagener DK, LaPorte RE, Orchard TJ, et al. The Pittsburgh diabetes mellitus study 3: An increased prevalence with older maternal age. *Diabetologia* 1983;25:82–85.
24. Thacker PD. Biological clock ticks for men, too: Genetic defects linked to sperm of older fathers. *JAMA* 2004;291:1683–1685.
25. Fisch H, Hyun G, Golden R, et al. The influence of paternal age on Downs Syndrome. *J Urol* 2003;169:2275–2278.
26. Lowe X, Eskenazi B, Nelson DO, et al. Frequency of XY sperm increases with age in fathers of boys with Klinefelter syndrome. *Am J Hum Genet* 2002;69:1046–1054.
27. Sartorelli EM, Mazzucatto LF, de Pina-Neto JM. Effects of paternal age on human sperm chromosomes. *Fertil Steril* 2001;76:1119–1123.
28. Fletcher NA, Foley J. Parental age, genetic mutation and cerebral palsy. *J Med Genet* 1993;30:44–46.
29. Auroux M. Age of the father and development. *Contracept Fertil Sex* 1993;21:382–385.
30. Friedman JM. Genetic disease in the offspring of older fathers. *Obstet Gynecol* 1981;57:745–749.
31. de la Rochebrochard E, Thonneau P. Paternal age > or = 40 years: An important risk factor for infertility. *Am J Obstet Gynecol* 2003;189:901–905.
32. Dunson DB, Colombo B, Baird DD. Changes with age in the level and duration of fertility in the menstrual cycle. *Hum Reprod* 2002;17:1399–1403.
33. Paulson RJ, Milligan RC, Sokol RZ. The lack of influence of age on male fertility. *Am J Obstet Gynecol* 2001;184:818–824.
34. Ford WC, North K, Taylor H, et al. Increasing paternal age is associated with delayed conception in a large population of fertile couples: Evidence for declining fecundity in older men. The ALSPAC Study Team (Avon Longitudinal Study of Pregnancy and Children). *Hum Reprod* 2000;15:1703–1708.
35. de la Rochebrochard E, Thonneau P. Paternal age and maternal age are risk factors for miscarriage: Results of a multicentre European study. *Hum Reprod* 2002;17:1649–1656.
36. Wunsch G, Gourbin C. Men's reproductive health: The impact of the age of the father on child survival. In: *Proceedings of the Seminar on Men, Family Formation and Reproduction*. Buenos Aires, Argentina: IUSSP-CENEP; 1998:1–12.
37. Leavitt JW. What do men have to do with it? Fathers and mid-twentieth-century childbirth. *Bull Hist Med* 2003;77:235–242.
38. Huang CY, Yang MC, Chen WJ: The characteristics of the laboring women and use of cesarean section: A case study of the NTU Hospital. *Chinese Public Health J* 1997;16:309–318.
39. Lo JC. Patients' attitudes vs. physicians' determination: Implications for cesarean sections. *Soc Sci Med* 2003;57:91–96.
40. Yip PS, Lee J, Cheung YB. The influence of the Chinese Zodiac on fertility in Hong Kong SAR. *Soc Sci Med* 2002;55:1803–1812.
41. Catching the Tail of Dragon—Maternal Request for Cesarean Section in the End of the Dragon Year. *Evening News Today*, 17 Jan 2001. Access at: http://www.jwb.com.cn/gb/content/2001-01/17/content_4205.htm.