Delivery settings and caesarean section rates in China
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Objective To quantify the influence of increasing use of health-care services on rising rates of caesarean section in China.
Methods We used data from a population-based survey conducted by the United Nations Population Fund during September 2003 in 30 selected counties in three regions of China. The study sample (derived from birth history schedule) consisted of 3803 births to mothers aged less than 40 years between 1993 and 2002. Multiple logistic regression models were used to estimate the effect of health-care factors on the odds of a caesarean section, controlling for time and selected variables.
Findings Institutional births increased from 53.5% in 1993–1994 to 82.2% in 2001–2002, while the corresponding increase in births by caesarean section was from 8.9% to 24.8%, respectively. Decomposition analysis showed that 69% of the increase in rates of caesarean section was driven by the increase in births within institutions. The adjusted odds of a caesarean section were 4.9 times (95% confidence interval, CI: 3.2–7.1) higher for women who had at least one antenatal ultrasound test. Rates of caesarean section in secondary-level facilities markedly increased over the last decade to the same levels as in major hospitals (P < 0.001).
Conclusion The upsurge in rates of births by caesarean section in this population cannot be fully explained by increases in institutional births alone, but is likely to be driven by medical practice within secondary-level hospitals and women’s demand for the procedure.


Introduction
Rates of caesarean section in many countries have increased beyond the recommended level of 15%,1 almost doubling in the last decade, especially in high-income areas such as Australia, France, Germany, Italy, North America and the United Kingdom of Great Britain and Northern Ireland (UK).2–2 Similar trends have also been documented in low-income countries such as Brazil, China and India, especially for births in private hospitals.9–12 Advanced health-care technologies are becoming more widely available in different regions of China. Following health-care reforms introduced in the 1990s, a large proportion of Chinese women, including those from the less-developed western region, now seek early antenatal and delivery care in health institutions. The number of caesarean-section births has increased sharply especially in the eastern region, which covers the major cities of Beijing, Shanghai and Tianjin.13 Recent evidence also shows increasing demand for caesarean section among young, educated women residing in urban areas.13 Many Chinese couples now delay childbirth, aiming to have not more than one birth experience and opt for delivery by caesarean section to avoid pain.13,14

Many Chinese couples now delay childbirth, aiming to have not more than one birth experience and opt for delivery by caesarean section to avoid pain.13,14 Data from hospital-based studies in urban China showed rates of caesarean section of between 26% and 63% during the late 1990s.15–18 Another population-based study reported a substantial increase during the last three decades, from 4.7% to 22.5%.12 These trends are expected to persist in view of the unparalleled economic growth and rapid expansion of private health care and health insurance systems across China. Apart from the clinical indications for caesarean section – breech presentation, dystocia and suspected fetal compromise – there is growing evidence that many women choose delivery by caesarean section for personal reasons, particularly in profit-incentivized institutional settings that may provide implicit or explicit encouragement for such interventions.13,15

The goal of our research was to quantify the influence of increased overall use of health-care services on rising rates of caesarean section in China. We hypothesized that the increase in institutional births and use of modern obstetric technologies explain the observed increase in rates of caesarean section.

Methods

Data sources
We used data from a population-based survey conducted during September 2003 in 30 selected counties covering all provinces in all three regions of China. The survey was coordinated by the United Nations Population Fund (UNFPA) in collaboration with China’s National Population and Family Planning Commission and health ministry. The counties were selected on the basis of planned future participation in UNFPA-linked reproductive health programmes. The sample of countries chosen in the survey was not intended to be nationally representative, but it covers the three regions and represents relatively developed Chinese areas in terms of socioeconomic status. The survey was based on household population records and the design included a stratified multi-stage selection of a sample of women aged 15–49.
years. The 30 selected counties defined a population of townships. In the first stage of the analysis, these were stratified by region (eastern, central, western) and by residence (rural or urban). Within each region, 35 townships were selected; this sample was divided between urban and rural strata proportional to the population of women aged 15–49 years, subject to a minimum urban sample of seven townships. At the second stage, four local communities were selected proportional to the population of women aged 15–49 years from each selected township. At the final stage, a systematic random sample of 20 women was selected from a list ordered by age of all women aged 15–49 years within each selected community. This led to a final sample of 8400 women aged 15–49 years from 8400 households (2800 women per region and 80 women from each of the 105 sampled townships).

The survey questionnaire contained a detailed section on birth history (the birth history schedule) that collected information on antenatal care and delivery for each pregnancy. The initial rates of participation were very high, and in the small number of cases where an interview was not obtained, the respondent was replaced by another respondent of the same age. Of 8400 women, 7432 were married at the time of the survey. In the birth history schedule, detailed information was recorded for 11 315 births that occurred between 1971 and 2003. However, for the analysis we considered 3814 births that took place between 1993 and 2002. Additionally, we selected only mothers whose age at delivery was less than 40 years. This age restriction ensured that the cross-sectional sample of mothers aged 15–49 years at the time of the survey properly represented births over a 10-year period.

The final selected sample for analysis included 3803 births that took place between 1993 and 2002 among 2829 mothers aged 15–39 years. Nearly 82% of mothers in the selected sample reported having received antenatal care. The proportion of institutional deliveries among the selected sample was 66.2% (n = 3803). Preliminary scrutiny of the data indicated that women from the eastern region, those who lived in urban areas, those who received education to senior high school level or above and those employed in the service or professional sectors were more likely to opt for an institutional delivery. For the detailed analysis, we considered only the 2516 births to 2267 mothers that took place in health-care institutions. Of these 2267 mothers, 89.3% gave birth to one child between 1993 and 2002, 10.4% had two children and less than 1% had three or more children.

Mothers were asked if their deliveries were vaginal or by caesarean section. We consider misreporting to be unlikely as a source of bias, as mothers were not likely to report a normal vaginal birth as a caesarean or vice versa. Those who had a caesarean delivery were also asked whether they had requested the procedure. The individual data were in anonymous format for analysis and ethical approval was not required.

**Statistical analysis**

Data were weighted to calculate the crude prevalence of caesarean birth – the difference in proportions between weighted and unweighted data was trivial. Binary logistic regression analysis was used to examine the effect of health-care variables on the odds of a caesarean birth. The dependent

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**Table 1. Trends in caesarean births and institutional births by year and region, 1993–2002**

<table>
<thead>
<tr>
<th>Region</th>
<th>Births by caesarean and/or in institution</th>
<th>Year of birth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
<td>Number of births</td>
<td>242</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>Overall CS (%)</td>
<td>7.3</td>
<td>10.1</td>
</tr>
<tr>
<td></td>
<td>Institutional births (%)</td>
<td>65.7</td>
<td>74.1</td>
</tr>
<tr>
<td></td>
<td>CS within institution (%)</td>
<td>11.2</td>
<td>13.6</td>
</tr>
<tr>
<td>Central</td>
<td>Number of births</td>
<td>272</td>
<td>227</td>
</tr>
<tr>
<td></td>
<td>Overall CS (%)</td>
<td>3.2</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Institutional births (%)</td>
<td>57.2</td>
<td>57.8</td>
</tr>
<tr>
<td></td>
<td>CS within institution (%)</td>
<td>5.6</td>
<td>5.7</td>
</tr>
<tr>
<td>West</td>
<td>Number of births</td>
<td>372</td>
<td>308</td>
</tr>
<tr>
<td></td>
<td>Overall CS (%)</td>
<td>3.9</td>
<td>6.4</td>
</tr>
<tr>
<td></td>
<td>Institutional births (%)</td>
<td>41.7</td>
<td>45.8</td>
</tr>
<tr>
<td></td>
<td>CS within institution (%)</td>
<td>8.8</td>
<td>14.1</td>
</tr>
<tr>
<td>All regions</td>
<td>Number of births</td>
<td>886</td>
<td>790</td>
</tr>
<tr>
<td></td>
<td>Overall CS (%)</td>
<td>4.9</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>Institutional births (%)</td>
<td>53.5</td>
<td>59.2</td>
</tr>
<tr>
<td></td>
<td>CS within institution (%)</td>
<td>8.9</td>
<td>11.7</td>
</tr>
</tbody>
</table>

CS, caesarean section.

* The percentages shown are based on weighted data controlling for mothers aged less than 40 years at delivery.

* Population-level estimates.
variable in the regression was mode of institutional delivery (caesarean section coded as indicator category and vaginal birth coded as reference category). The health-care variables considered in the statistical analysis included use of antenatal care and associated specific components of care received during pregnancy. These included ultrasound scanning, measurement of blood pressure, abdominal examination, and clinical tests of liver function, haemoglobin and urine. Other control variables in the analysis included year of birth to control for period effects, mother’s place and region of residence, age at birth, family size, education and occupation. We did not consider the mode of delivery for a previous birth as a control variable since the sample consisted predominantly of primigravidae. The variables included in the regression model were screened for problems of multi-collinearity, and variables that were highly correlated with each other were excluded from the model. Additionally, we applied decomposition methods to differentiate the relative contribution of the underlying trends in institutional births to the increase in rates of caesarean section. Decomposition techniques incorporate interactive effects between the compositional changes in the variables and explain whether an increase over time in institutional births contributes to an increase in caesarean births.

Results

The overall population-level estimate of rates of caesarean section increased in a linear manner from 4.9% in 1993–1994 to 20.4% in 2001–2002 (Table 1). Rates of institutional delivery during these periods were 53.5% and 82.2%, respectively. Within institutional settings, rates of caesarean section increased linearly from 8.9% in 1993–1994 to 24.8% in 2001–2002. Had rates of caesarean section within institutions remained constant at the level of 8.9% observed in 1993–1994, the overall rate of caesarean section would have risen only to 7.3% during 2001–2002. Had the proportion of births that took place in institutional settings remained constant at 53.5%, rates of caesarean section would have increased to only 13% during 2001–2002. The decomposition analyses suggest that 69.0% of the increase in rates of caesarean section was driven by the increase in births within institutions; the increase was particularly notable in the central (78.0%) and eastern (73.7%) regions (results not shown separately). The relative contribution of the underlying trends in institutional births to the increase in deliveries by caesarean was 54.1% in the western region; this indicates that more than 40% of the increase seen in the western region was attributable to factors other than the increase in institutional deliveries. The western region is relatively less developed than other regions, in which large-scale poverty alleviation and maternal and child mortality reduction programmes have been in place since 1999.21,22

The trends in rates of caesarean section were further established using regression analysis (Table 2). After controlling for selected health-care, demographic and social factors, the results showed that the odds of an institutional birth during 1999–2002 being by caesarean section were 4.6 times (95% confidence interval, CI: 2.8–7.7) greater when compared with that during 1993–1994 (P < 0.001). The use of ultrasound scanning at least once during the pregnancy had a significant effect on the odds of having a caesarean section; the odds for a caesarean section were 1.6 times greater for women who received antenatal care with at least one ultrasound scan than for those who had received antenatal care with no ultrasound.

Fig. 1. Rates of birth by caesarean section: trends attributed to levels of institutional births and use of caesarean section within institutions, 1993–2002*
scan. However, mothers who had had no formal antenatal care but who gave birth in a health-care institution were significantly more likely to have undergone a caesarean section. A higher proportion of mothers who gave birth in general hospitals and family planning hospitals at the county level had caesarean sections compared with those who delivered in smaller hospitals, such as township general and family planning hospitals. The county-level hospitals usually cater to a larger population, including referral cases from township-level and other hospitals within a township. The odds of a caesarean delivery were about 2.6 times higher in a maternal and child health (MCH) hospital at the county level than in other small township-level hospitals ($P < 0.001$). All control variables except parity and place of residence were statistically significant in the regression. The odds of a caesarean section were significantly higher for mothers with only one child when compared to those with more than one birth. About 75% of women who had a caesarean birth had only one child at the time of survey.

We examined the possibility that there was an interaction effect between place of delivery and year of birth. For reasons of adequate sample size within each category, we merged the big hospitals (general and county-level family planning hospitals) to create the indicator category, and merged other hospitals including MCH hospitals for the reference category. The interaction effect was statistically highly significant. The results showed that the odds of a recent birth being by caesarean section was nearly 60% greater in smaller hospitals when compared with larger hospitals where the levels of caesarean section were already very high. The rise in rates of caesarean section in the township-level and MCH hospitals relative to other larger hospitals is illustrated in terms of adjusted predicted probabilities (Fig. 2). In MCH hospitals, the rate of caesarean section increased from 8.2% during 1993–94 to 29.3% during 2001–02, almost equaling that in the major family planning and general hospitals at the county level. In the survey, women were asked whether they had requested a caesarean delivery. Among those who had a birth during 2001–2002, 50.7% responded in the affirmative; this compares with an overall figure of 44.7% for the decade preceding the survey. Mothers who resided in urban areas and the western region, those who had senior high school education and above, and those employed in professional and service sectors were more likely to respond in the affirmative to this question (results not shown separately).

### Discussion

The increase in rates of caesarean delivery observed over time in our study population was not fully explained by the increase in the rates of institutional birth alone. Instead, they were likely to be driven by the twin pressures of obstetricians favouring recourse to caesarean delivery and women’s demand for the procedure. The analysis demonstrated that use of antenatal care, especially ultrasound scanning, was also associated with a greater likelihood of caesarean delivery. The availability and widespread use of ultrasound scanning indicates the extent of use (medicalization) of antenatal care services by women in the study area and could be either a marker for a type of patient who prefers medical intervention, or a marker for a type of medical behaviour whereby doctors might be inclined to offer both scanning and caesarean delivery. There were considerable differences between types of hospital: rates increased over the decade in the large general hospitals, but this increase was from a high baseline. Secondary-level hospitals started from a low baseline but increased their rates of

### Table 2. Likelihood of having a delivery by caesarean section within an institution for 2516 mothers aged less than 40 years

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Unadjusted proportions</th>
<th>Adjusted$^a$ odds ratios (95% confidence interval)</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993–1994 (reference category)</td>
<td>8.9</td>
<td>1.0</td>
<td>–</td>
</tr>
<tr>
<td>1995–1996</td>
<td>11.6</td>
<td>1.4 (0.9–2.2)</td>
<td>0.155</td>
</tr>
<tr>
<td>1997–1998</td>
<td>12.9</td>
<td>1.4 (0.9–2.2)</td>
<td>0.109</td>
</tr>
<tr>
<td>1999–2000</td>
<td>18.8</td>
<td>3.5 (2.1–6.0)</td>
<td>0.000</td>
</tr>
<tr>
<td>2001–2002</td>
<td>25.3</td>
<td>4.6 (2.8–7.7)</td>
<td>0.000</td>
</tr>
<tr>
<td>ANC components$^b$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least one ANC component and ultrasound</td>
<td>14.2</td>
<td>1.0</td>
<td>–</td>
</tr>
<tr>
<td>All selected ANC components and ultrasound</td>
<td>25.2</td>
<td>1.4 (1.1–1.9)</td>
<td>0.010</td>
</tr>
<tr>
<td>At least one ANC component and no ultrasound</td>
<td>7.1</td>
<td>0.6 (0.4–1.1)</td>
<td>0.092</td>
</tr>
<tr>
<td>Had ANC only at time of delivery</td>
<td>13.0</td>
<td>1.2 (0.8–1.9)</td>
<td>0.431</td>
</tr>
<tr>
<td>Place of delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other$^c$</td>
<td>7.2</td>
<td>1.0</td>
<td>–</td>
</tr>
<tr>
<td>General hospital</td>
<td>24.2</td>
<td>5.9 (3.8–9.0)</td>
<td>0.000</td>
</tr>
<tr>
<td>Maternal and child health hospital</td>
<td>19.7</td>
<td>2.6 (1.8–3.7)</td>
<td>0.000</td>
</tr>
<tr>
<td>County family planning hospital</td>
<td>22.1</td>
<td>6.5 (3.2–13.1)</td>
<td>0.000</td>
</tr>
<tr>
<td>General hospital, or county family planning hospital and birth between 1999 and 2002</td>
<td>29.3</td>
<td>0.4 (0.3–0.7)</td>
<td>0.000</td>
</tr>
<tr>
<td>Constant</td>
<td>NA</td>
<td>–6.663</td>
<td>0.000</td>
</tr>
<tr>
<td>$–2$ log-likelihood</td>
<td>NA</td>
<td>1911</td>
<td>–</td>
</tr>
</tbody>
</table>

ANC, antenatal care clinic; NA, not applicable.

$^a$ Adjusted for maternal age, family size, occupation and region of residence of mother.

$^b$ Antenatal care includes measurement of weight, tests on blood, urine and of liver function, abdominal examinations and test for hypertension.

$^c$ “Other” includes private clinics and township general and family planning hospitals.
caesarean section substantially towards the end of the decade, reaching the same level as the major hospitals. A similar trend was evident in other health facilities, such as small township-level family planning hospitals and private clinics.

The data were obtained from a population sample stratified by place of residence, accounting for variations in socioeconomic conditions currently prevalent in China. The findings reported directly apply to the selected counties in the survey, which give a wide geographic coverage of the country. However, the results cannot be generalized to the whole country owing to the purposive selection of the project counties. Specific health-service interventions to strengthen maternal and other reproductive health-care provisions have been initiated in these counties; it is possible that a different pattern of associations with caesarean delivery would have been observed in other areas. The survey enquired whether women had expressed a preference for caesarean delivery. This was a single item in the questionnaire that did not allow for elaboration to give the full picture of the decision-making process between doctors and patients, for which in-depth studies would be required. We were not able to determine whether medical indications for caesarean section were present.

The present findings are consistent with the national pattern of a steady increase in caesarean sections in China, a country where health-care services are undergoing rapid expansion and modernization. Within the limitations discussed above, our data show a huge demand for the procedure across urban and rural areas of China in the context of the overall acceptance of the “one-child norm.” The finding that women with only one child were more likely to undergo a caesarean section may reflect women’s perceptions regarding the efficacy of the procedure as a means to ensure newborn survival and to avert the risks of birth complications or stillbirth. Consistent with our findings, a cohort study showed that women are increasingly inclined to opt for delivery by caesarean for non-medical reasons such as fear of labour pain, concerns about date or time of birth that are traditionally believed to be auspicious and the belief that delivery by caesarean ensures protection of the baby’s brain.

Aside from the medical benefits and risks of caesarean delivery for individual women, an important consideration is the economic impact of this new trend. Data gathered during evaluation activities in one of the study areas in 2005 indicated that the cost of caesarean delivery is approximately 2000–3000 Chinese yuan (approximately US$ 262–394) in rural areas. This includes the cost of the actual delivery, a 1-week hospital stay, food and transportation. The corresponding costs in an urban facility range from 5000 to 7000 yuan (approximately US$ 656–918) to more than 10 000 yuan (approximately US$ 1312) in major hospitals in big cities. While fees are not typically paid by mothers directly to obstetricians, in the context of a diversifying health economy in which institutions benefit from increasing activity there are performance-related incentives for staff in some hospitals, depending on the number of procedures and the revenue that physicians generate for their hospitals.

It is worth noting here that the trends in rates of caesarean section seen in the present study corresponded very closely to those at the facilities in a selected county sample where we conducted our field evaluation. Although we cannot generalize, this observation to some extent provides reassurance as to the validity of survey estimates.

The associations between antenatal care, sonography and caesarean delivery may contain some element of self-selection; for example, women with high-risk pregnancies and identified problems are presumably more likely to be advised to have more consultations and investigations such as ultrasound. On the other hand, it is possible that increased use of antenatal services leads to increased medicalization of the pregnancy, including a greater openness to caesarean delivery. Overall, routine sonography in late pregnancy has not been shown to improve perinatal mortality and there is limited sensitivity and specificity for
Influence du lieu où s’effectue l’accouchement sur les taux de césarienne en Chine

Objectif Quantifier l’influence du recours accru aux services de santé sur les taux de césarienne en Chine.


Résultats La proportion des naissances enmaternité est passée de 53,5 % pendant la période 1993-1994 à 82,2 % pendant la période 2001-2002, tandis que le taux de naissance par césarienne correspondant augmentait de 8,9 à 24,8 %. L’analyse par décomposition a fait apparaître que 69 % de l’accroissement des taux de césariennes découle de l’augmentation du taux de naissance en maternité. Les probabilités ajustées d’accouchement par césarienne étaient 4,6 fois plus élevées (intervalle de confiance à 95 %, IC : 3,4-11,8) pour les naissances récentes. Ces probabilités de naissance en maternité. Les probabilités ajustées d’accouchement par césarienne étaient 4,6 fois plus élevées pour les naissances récentes. Ces probabilités étaient aussi significativement supérieures pour les mères ayant subi au moins une échographie anténatale. Les taux d’accouchement par césarienne dans des établissements de soins de santé secondaire ont augmenté notablement sur la dernière décennie, jusqu’à atteindre des niveaux analogues à ceux des grands hôpitaux (p < 0,001).

Conclusion Les très fortes augmentations des taux de naissance par césarienne dans la population considérée ne peuvent s’expliquer totalement par l’accroissement des taux de naissances en maternité, mais sont aussi probablement imputables aux pratiques médicales des établissements de soins de santé secondaire et à la demande des femmes.
Resumen

Entorno de parto y tasas de cesárea en China

Objetivo Cuantificar la influencia del aumento del uso de los servicios de salud en el incremento de las tasas de cesárea en China.

Métodos Los datos empleados proceden de una encuesta poblacional llevada a cabo por el Fondo de Población de las Naciones Unidas durante septiembre de 2003 en 30 circunscripciones de tres regiones de China. La muestra estudiada (obtenida a partir de una lista de historias genéricas) abarcaba 3803 partos de madres de menos de 40 años registrados entre 1993 y 2002. Se usaron modelos de regresión logística múltiple para calcular el efecto de diversos factores relacionados con la salud en la probabilidad de cesárea, controlando el tiempo y otras variables.

Resultados Los partos en instituciones aumentaron de un 53,5% en 1993-1994 al 82,2% en 2001-2002, y entre esas fechas los nacimientos por cesárea aumentaron del 8,9% al 24,8%. El análisis de descomposición mostró que el 69% del aumento de las tasas de cesárea se debió al incremento de los nacimientos en instituciones. La probabilidad ajustada de cesárea fue 4,6 veces (intervalo de confianza (IC) del 95%: 3,4-11,8) mayor para los nacimientos recientes. La probabilidad ajustada fue también significativamente mayor para las madres que se habían sometido al menos a una ecografía prenatal. Las tasas de cesárea en los establecimientos de nivel secundario aumentaron sensiblemente durante el último decenio, hasta alcanzar los mismos valores que en los hospitales principales ($P < 0,001$).

Conclusión El repunte de las tasas de parto por cesárea en esta población no puede explicarse sólo por el aumento de los nacimientos en instituciones. Probablemente hay que tener también en cuenta la evolución del ejercicio de la medicina en los hospitales de nivel secundario y la demanda de ese procedimiento por las mujeres.

Referencias


