Factors influencing rising caesarean section rates in China between 1988 and 2008

Xing Lin Feng,[a] Ling Xu,[b] Yan Guo[a] & Carine Ronsmans[c]

Objective To identify factors driving the rapid increase in caesarean section in China between 1988 and 2008.
Methods Data from four national cross-sectional surveys (1993, 1998, 2003 and 2008) and modified Poisson regression were used to determine whether changes in household income, access to health insurance or women's education accounted for the rise in caesarean sections in urban and rural areas.
Findings In 2008, 64.1% of urban women and 11.3% of women in the poorest rural region reported giving birth by caesarean section. A fast rise was occurring in all socioeconomic groups. Between 1993 and 2008, the risk of caesarean section had increased more than threefold in urban areas (relative risk, RR: 3.63; 95% confidence interval, CI: 2.61–5.04) and more than 15-fold in rural areas (RR: 15.46; 95% CI: 10.46–22.86). After adjustment for improvements in income, education and access to health insurance over the study period, the RR dropped minimally in urban areas (RR: 3.07; 95% CI: 2.32–4.07), which suggests that these factors do not explain the rise; in rural areas, the adjusted RR dropped to 7.18 (95% CI: 4.82–10.69), which shows that socioeconomic change is only partly responsible for the rise. Socioeconomic region of residence was a more important driver of the caesarean section rate than individual socioeconomic status.
Conclusion The large variation in caesarean section rate by socioeconomic region – independent of individual income, health insurance or education – suggests that structural factors related to service supply have influenced the increasing rate more than a woman's ability to pay.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

Concern has been expressed about the global rise in caesarean section, particularly in Latin America.[1–6] Caesarean section rates in Asia are generally thought to be lower, though some countries have also experienced an unprecedented rise.[1,7–9] Between 1990 and 2002, the rate among primiparous women living in cities in China rose from 18% to 39%[8] and close to two thirds of urban women now give birth by caesarean section.[10–12] Although the rate in rural China has risen more slowly, it is now thought to be above 25%.[9,13,14]

Opinions differ on why the rate has risen so rapidly in China. The country has the highest rate for caesarean section without a specific indication in Asia,[7] far in excess of medical need. Both increased demand and increased supply have been proposed as drivers. On the demand side, women may request a caesarean section because they fear the consequences of vaginal delivery.[10,12,15–17] When having one child is the norm, rich and well educated women may prefer birth by caesarean section to vaginal delivery because they think it is safer and free from pain and anxiety.[12,15–17] More evidence for this reasoning comes from the high proportion of indications for caesarean section categorized as "woman's request" or "due to social factors" in hospital records[10,12,15–17] and from the persistently higher rates observed among rich and well educated women.[8,9,14,18]

In contrast, others have emphasized health system factors, arguing that the rise in demand for caesarean section is largely stimulated by health-care providers and results from perverse financial incentives that encourage costly procedures.[8,10,13,14,19,20] Total expenditure on caesarean section in China has certainly risen dramatically and the procedure has become an important source of revenue for hospitals and health-care providers.[10,13,14] The increased funding available through insurance schemes is also thought to have boosted demand.[10,13,14,18] In particular, the New Cooperative Medical System, a health insurance scheme introduced in rural China in 2003, may have encouraged caesarean section delivery by increasing the revenue of health-care providers.[13,14] Urban health insurance schemes have also been implicated,[10,18] but evidence that health insurance has encouraged caesarean section in China is weak.[13]

The aim of this study was to investigate the factors responsible for the increase in caesarean section in China between 1988 and 2008. Previous analyses reported on socioeconomic differences in the rate observed in urban[8] and rural[9] primiparous women between 1988 and 2003. However, no efforts have been made to document trends within women of a similar socioeconomic status or who have the same parity or to examine empirically the factors that explain the rate rise over time. We hypothesized that, if the caesarean section epidemic is fuelled by perverse financial incentives, then it should be possible to attribute a large part of the rise to the dramatic increase in wealth and access to health insurance experienced by Chinese families over recent decades. We used data from four national cross-sectional surveys to examine how much of the rise in the caesarean section rate is explained by the changes in household income and access to health insurance and education that occurred between 1988 and 2008. We also investigated whether the rate of the increase was greater among better-educated and wealthier women, those with health insurance and those who had a second or higher order birth. We analysed urban

[a] Department of Health Policy and Administration, Peking University School of Public Health, Beijing, China.
[b] Statistics and Information Centre, Ministry of Health, Beijing, China.
[c] Department of Infectious Disease Epidemiology, London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E 7HT, England.
Correspondence to Carine Ronsmans (e-mail: carine.ronsmans@lshtm.ac.uk)
(*Submitted: 11 May 2011 – Revised version received: 22 August 2011 – Accepted: 23 August 2011 – Published online: 6 October 2011*)

and rural areas separately because of differences in socioeconomic factors and health insurance schemes.

Methods

We obtained data from four cross-sectional National Health Service Surveys conducted in China in 1993, 1998, 2003 and 2008. Later surveys used the same sampling units as the 1993 survey, with some minor modifications over time. The 1993 survey had a four-stage, stratified, cluster, random sampling design. In the first stage, cities and counties were randomly selected from the five socioeconomic strata used by the Chinese Ministry of Health to divide the country into socioeconomic regions according to a range of social and economic indicators derived from the 1982 census.[21] Then, five districts or townships were sampled within each city or county, respectively. Two villages were sampled within each district or township and a random sample of households was selected from each village for each survey.

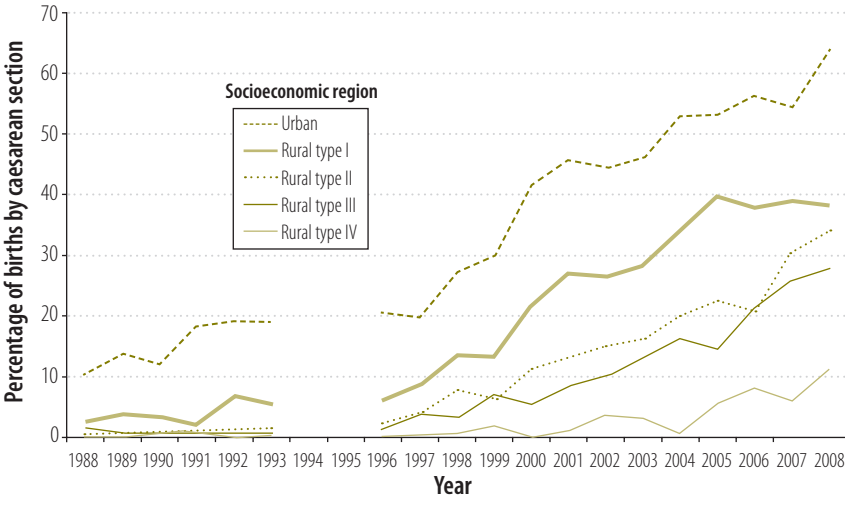
Interviews were carried out in all households by trained health workers using a structured questionnaire that collected information on the characteristics of pregnancies in the period before the survey. The recall period was 6 years for the 1993 survey, 2 years for the 1998 survey and 5 years for the 2003 and 2008 surveys. Data for 1994 and 1995 were missing. The 1993 and 1998 surveys recorded data on the last pregnancy, while the 2003 and 2008 surveys recorded information on the last live birth. All surveys detailed where the birth had taken place, the number of antenatal visits and the mode of delivery. All multiple births ending in at least one live birth were included.

Our study analysed only a limited number of the comprehensive list of sociodemographic indicators included in the questionnaires because many were correlated with each other and because we wished to ensure consistency with previous analyses.[8,9,14] The variables selected were: the socioeconomic region of residence, household annual income, the woman's educational attainment, access to health insurance, maternal age and parity. Each socioeconomic region was categorized as either urban, which included large, medium and small cities, or as one of four rural regions: type I, II, III or IV, with type IV being the poorest. Each household's annual per capita income, defined as the gross household income divided by the number of individuals in the household, was adjusted in line with annual consumer price indices to correct for variations relative to 2008. Separate indices were used for urban and rural areas to take into account differences between these areas. Subsequently, inflation-adjusted annual incomes for the period 1988 to 2008 were divided into four quartiles for urban and rural areas separately. Absolute income ranges therefore varied between urban and rural areas. For example, the poorest quartile in rural areas had an annual per capita income of less than 915 Chinese yuan (equivalent to 127 United States dollars at the 2008 exchange rate) compared with less than 2666 yuan (US$ 371) per capita in urban areas. The richest quartile in rural areas, on the other hand, had an income of more than 2787 yuan (US$ 388) per capita compared with more than 7474 yuan (US$ 1040) per capita in urban areas. Health insurance included any social or private health insurance reported by the women.

Our analysis was restricted to live births and the outcome of interest was the percentage of births by caesarean section. To ensure that our findings were representative of the whole country, data were weighed against the probability that an individual would be included in the sample. We calculated the probability of being selected for the sample at the city or county level by dividing the size of sampled population by the total population in each city or county, respectively. The total population was calculated using data from the census closest to the date of the survey.

We used a modified Poisson regression approach,[22,23] which made allowances for clustering at the city, county or village level and for stratification, to derive crude and adjusted relative risks (RRs) for caesarean section over time in urban and rural areas separately. Time was modelled as a categorical variable (i.e. the year of the survey). Crude comparisons by survey year were adjusted for per capita income, access to health insurance, the mother's educational attainment and parity. Variables were added individually to examine changes in the magnitude of the RR over time. The final models were adjusted for maternal age and the number of antenatal visits because these variables have previously been reported to be associated with caesarean section.[9] We also investigated whether the increase in the percentage of births by caesarean section was influenced by the mother's educational attainment, household income, health insurance or parity.

Fig. 1. **Caesarean section rate in China, 1988–2008,[a] by socioeconomic region[b]**



[a] The data for 1994 and 1995 were missing.

[b] The Chinese Ministry of Health divided the country into five socioeconomic regions according to social and economic indicators in the 1982 census: urban and rural types I, II, III and IV, with type IV being the poorest.

Results

Data on the mode of delivery were available for 34 482 live births in China between 1988 and 2008. Table 1 (available at: http://www.who.int/bulletin/volumes/90/1/11-090399)shows the changes over that period in household income, access to health insurance and the women's educational attainment and parity in urban and rural areas separately. Educational attainment and household income increased dramatically in urban areas: 26% of women who reported a live birth reached a college or higher level of education in the 2008 survey and 51% of their households belonged to the wealthiest quartile. Similar increases were seen among rural women, though very few received a college education. Access to health insurance changed substantially for rural women after 2003 when the New Cooperative Medical System was introduced. More than three quarters of all births in urban areas were first births throughout the study period. In rural areas, the proportion of first births increased dramatically from 37.7% to 68.3% between the 1993 and 1998 surveys. After 2000, the proportion of first births in rural areas decreased to about half.

Nationally, the caesarean section rate rose dramatically from 3.4% in 1988 to 39.3% in 2008. Although the rate increased in all socioeconomic regions, the most extraordinary increase was seen among urban women, 64.1% of whom gave birth by caesarean section in 2008 (Fig. 1). Even in the least developed region, rural type IV, the rate rose from 0% in1988 to 11.3% in 2008.

Table 2 shows the change in the caesarean section rate in urban areas since the 1993 survey and how that change related to household income, access to health insurance and the women's educational attainment and parity. The rate increased more than threefold between the 1993 and 2008 surveys (crude RR: 3.63, 95% confidence interval, CI: 2.61–5.04). Caesarean section was more common in

Table 2. **Determinants of caesarean section in urban China, 1988–2008**

Determinant	No. of live births by caesarean section	Relative risk of caesarean section (95% confidence interval)					
		%	Crude	Adjusted for survey year and household income	Adjusted for survey year, household income and health insurance	Adjusted for survey year, household income, health insurance and educational attainment	Adjusted for all variables[a]
Year of survey							
1993[b]	2354	14.9	1.00	1.00	1.00	1.00	1.00
1998	702	19.9	1.33 (0.85–2.08)	1.22 (0.75–1.98)	1.28 (0.78–2.11)	1.30 (0.85–1.99)	1.25 (0.85–1.83)
2003	1863	37.9	2.54 (1.78–3.63)	2.23 (1.55–3.21)	2.40 (1.65–3.50)	2.34 (1.69–3.24)	2.30 (1.76–3.01)
2008	1478	54.1	3.63 (2.61–5.04)	2.92 (2.01–4.23)	3.06 (2.11–4.44)	3.08 (2.22–4.27)	3.07 (2.32–4.07)
Household income[c]							
Quartile 1[b]	1349	16.1	1.00	1.00	1.00	1.00	1.00
Quartile 2	1205	21.3	1.49 (1.16–1.90)	1.38 (1.10–1.72)	1.32 (1.08–1.62)	1.22 (1.02–1.45)	1.13 (0.98–1.30)
Quartile 3	1275	37.4	1.96 (1.46–2.63)	1.48 (1.17–1.87)	1.39 (1.11–1.74)	1.25 (1.03–1.51)	1.13 (0.96–1.32)
Quartile 4	1276	49.6	2.90 (2.14–3.95)	1.76 (1.36–2.28)	1.59 (1.23–2.07)	1.33 (1.06–1.66)	1.18 (0.98–1.44)
Health insurance							
No[b]	2651	26.4	1.00	–	1.00	1.00	1.00
Yes	3746	33.5	1.27 (1.03–1.56)	–	1.24 (1.05–1.46)	1.15 (1.01–1.31)	1.11 (0.99–1.25)
Mother's education							
None[b]	262	5.0	1.00	–	–	1.00	1.00
Primary school	2639	22.3	4.49 (2.33–8.65)	–	–	3.43 (1.70–6.89)	2.92 (1.35–6.28)
Secondary school	2247	34.5	6.94 (3.36–14.32)	–	–	4.91 (2.43–9.92)	3.79 (1.73–8.30)
College and above	1234	48.0	9.65 (4.74–19.64)	–	–	5.25 (2.69–10.24)	4.00 (1.87–8.54)
Parity							
1[b]	5347	32.9	1.00	–	–	–	1.00
2	853	20.7	0.63 (0.45–0.87)	–	–	–	0.74 (0.65–0.85)
≥ 3	190	11.8	0.36 (0.18–0.71)	–	–	–	0.66 (0.42–1.03)

[a] Adjusted for survey year, household income, educational attainment, health insurance, maternal age, parity and number of antenatal visits.
[b] Reference category.
[c] Household income was the per capita annual income, defined as the gross household income divided by the number of individuals in the household, adjusted to 2008 values using separate annual consumer price indices for urban and rural areas. Subsequently, respondents were divided into household income quartiles in rural and urban areas separately.
The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.

Table 3. **Determinants of caesarean section in rural China, 1988–2008**

Determinant	No. of live births by caesarean section (%)	Relative risk of caesarean section (95% confidence interval)				
		Crude	Adjusted for survey year and household income	Adjusted for survey year, household income and health insurance	Adjusted for survey year, household income, health insurance and educational attainment	Adjusted for all variables[a]
Year of survey						
1993[b]	11 373 (1.5)	1.00	1.00	1.00	1.00	1.00
1998	3 276 (3.6)	2.38 (1.54–3.68)	1.82 (1.17–2.82)	1.91 (1.28–2.86)	1.91 (1.28–2.86)	1.72 (1.19–2.50)
2003	7 174 (11.6)	7.58 (4.86–11.82)	5.71 (3.73–8.75)	5.90 (3.98–8.74)	5.78 (3.91–8.53)	5.25 (3.77–7.30)
2008	6 290 (23.6)	15.46 (10.46–22.86)	8.49 (5.58–12.93)	6.66 (3.98–11.15)	6.70 (4.05–11.09)	7.18 (4.82–10.69)
Household income[c]						
Quartile 1[b]	5 882 (1.7)	1.00	1.00	1.00	1.00	1.00
Quartile 2	5 376 (3.2)	1.65 (1.27–2.14)	1.34 (1.04–1.74)	1.34 (1.03–1.74)	1.29 (0.99–1.67)	1.11 (0.86–1.43)
Quartile 3	5 386 (11.0)	3.67 (2.79–4.84)	1.85 (1.40–2.42)	1.80 (1.38–2.36)	1.69 (1.30–2.19)	1.39 (1.07–1.81)
Quartile 4	5 617 (22.9)	9.36 (6.78–12.92)	3.04 (2.20–4.21)	2.91 (2.15–3.93)	2.59 (1.94–3.46)	1.43 (1.04–1.97)
Health insurance						
No[b]	19 860 (4.9)	1.00	–	1.00	1.00	1.00
Yes	8 253 (19.1)	3.93 (3.15–4.90)	–	1.45 (1.06–1.98)	1.42 (1.04–1.92)	1.32 (1.06–1.64)
Mother's education						
None[b]	4 831 (3.0)	1.00	–	–	1.00	1.00
Primary school	21 323 (9.4)	3.09 (2.10–4.53)	–	–	1.47 (1.09–1.99)	1.07 (0.84–1.37)
Secondary school	1 677 (17.7)	5.86 (3.78–9.07)	–	–	2.22 (1.63–3.02)	1.21 (0.96–1.51)
College and above	219 (29.5)	9.75 (6.09–15.63)	–	–	2.40 (1.68–3.43)	1.52 (1.20–1.91)
Socioeconomic region[d]						
Rural type IV[b]	4 982 (1.7)	1.00	–	–	–	1.00
Rural type III	9 333 (7.2)	4.15 (2.26–7.60)	–	–	–	2.94 (1.80–4.80)
Rural type II	8 262 (8.7)	5.03 (2.68–9.43)	–	–	–	3.36 (2.01–5.63)
Rural type I	5 536 (15.5)	8.91 (4.65–17.05)	–	–	–	4.85 (2.88–8.19)
Parity						
1[c]	13 288 (12.2)	1.00	–	–	–	1.00
2	10 155 (7.5)	0.62 (0.52–0.74)	–	–	–	0.70 (0.62–0.79)
≥ 3	4 643 (2.6)	0.22 (0.16–0.30)	–	–	–	0.54 (0.41–0.71)

[a] Adjusted for survey year, household income, educational attainment, health insurance, maternal age, parity and number of antenatal visits.
[b] Reference category.
[c] Household income was the per capita annual income, defined as the gross household income divided by the number of individuals in the household, adjusted to 2008 values using separate annual consumer price indices for urban and rural areas. Subsequently, respondents were divided into household income quartiles in rural and urban areas separately.
[d] The Chinese Ministry of Health divided rural areas of the country into four socioeconomic regions according to social and economic indicators in the 1982 census: rural types I, II, III and IV, with type IV being the poorest.
The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.

well educated and wealthy women and in those with health insurance. However, adjusting for these three factors plus parity, maternal age, the number of antenatal visits and the year of the survey had little effect on the RR: the fully adjusted RR of caesarean section in the 2008 survey compared with that of 1993 was 3.07 (95% CI: 2.32–4.07). This suggests that the increase in urban areas cannot be explained by changes in education, income or health insurance. Although educational attainment remained a significant determinant of caesarean section in the adjusted analysis, income and health insurance did not. The caesarean section rate was much lower in women who had given birth previously than in those giving birth for the first time.

The picture was somewhat different in rural areas (Table 3). The caesarean section rate rose more than 15-fold between the 1993 and 2008 surveys (crude RR: 15.46, 95% CI: 10.46–22.86). Adjustment for household income resulted in a marked decrease in the relative risk in the 2008 survey compared with that of 1993, to 8.49 (95% CI: 5.58–12.93). In comparison, the fully adjusted RR was

Table 4. **Trends in caesarean section in urban and rural China, 1988–2008, by household income, access to health insurance, women's education and parity**

Characteristic	Reference	Relative risk of caesarean section (95% confidence interval)			*P* for interaction
	1993	1998	2003	2008	
Urban areas					
Household income[a]					
Quartile 1	1.00	1.51 (1.00–2.27)	2.58 (1.94–3.43)	3.16 (2.17–4.61)	0.2234
Quartile 2	1.00	1.14 (0.81–1.62)	1.92 (1.53–2.41)	2.29 (1.74–3.01)	
Quartile 3	1.00	1.35 (0.95–1.91)	1.99 (1.53–2.41)	2.44 (1.87–3.20)	
Quartile 4	1.00	3.85 (1.87–7.93)	5.07 (2.61–9.84)	6.15 (3.18–11.89)	
Health insurance					
No	1.00	2.93 (2.01–4.26)	6.17 (4.55–8.36)	8.26 (6.04–11.28)	< 0.0001
Yes	1.00	1.60 (1.27–2.01)	2.13 (1.83–2.49)	2.70 (2.34–3.11)	
Mother's education					
None or primary	1.00	1.59 (1.15–2.20)	2.82 (2.26–3.52)	3.84 (3.07–4.80)	0.1604
Secondary	1.00	1.47 (1.10–1.95)	2.46 (2.03–2.99)	3.02 (2.48–3.68)	
College and above	1.00	1.39 (0.94–2.05)	1.84 (1.39–2.43)	2.39 (1.82–3.13)	
Parity					
1	1.00	1.43 (1.18–1.73)	2.40 (2.10–2.74)	3.19 (2.79–3.64)	0.0818
≥ 2	1.00	2.75 (1.37–5.52)	4.05 (2.57–6.38)	6.18 (4.06–9.42)	
Rural areas					
Household income[a]					
Quartile 1	1.00	1.54 (0.60–3.97)	8.99 (5.93–13.62)	12.13 (6.79–21.69)	0.0026
Quartile 2	1.00	1.82 (1.08–3.08)	6.41 (4.52–9.08)	8.28 (5.44–12.61)	
Quartile 3	1.00	1.30 (0.81–2.09)	4.74 (3.40–6.62)	7.54 (5.42–10.50)	
Quartile 4	1.00	1.27 (0.82–1.95)	2.89 (2.06–4.05)	4.57 (3.30–6.31)	
Health insurance					
No	1.00	3.16 (2.35–4.23)	10.02 (8.03–12.51)	28.71 (21.90–37.65)	< 0.0001
Yes	1.00	1.24 (0.68–2.26)	3.22 (2.38–4.34)	4.33 (3.35–5.60)	
Mother's education					
None	1.00	1.78 (0.70–4.50)	6.74 (3.79–12.01)	16.56 (9.49–28.88)	0.0034
Primary	1.00	2.51 (1.88–3.35)	7.78 (6.31–9.59)	15.61 (12.75–19.11)	
Secondary and above	1.00	1.32 (0.68–2.56)	3.14 (2.09–4.72)	6.50 (4.48–9.42)	
Parity					
1	1.00	1.66 (1.24–2.23)	5.56 (4.47–6.91)	10.71 (8.67–13.23)	< 0.0001
≥ 2	1.00	1.95 (1.13–3.35)	8.02 (5.95–10.81)	21.94 (16.61–28.98)	

[a] Household income was the per capita annual income, defined as the gross household income divided by the number of individuals in the household, adjusted to 2008 values using separate annual consumer price indices for urban and rural areas. Subsequently, respondents were divided into household income quartiles in rural and urban areas separately.

The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.

7.18 (95% CI: 4.82–10.69). This suggests that increasing income explained a large part of the rate rise in rural areas. However, the effect of the socioeconomic region on the rate remained substantial even after full adjustment for other variables (Table 3).

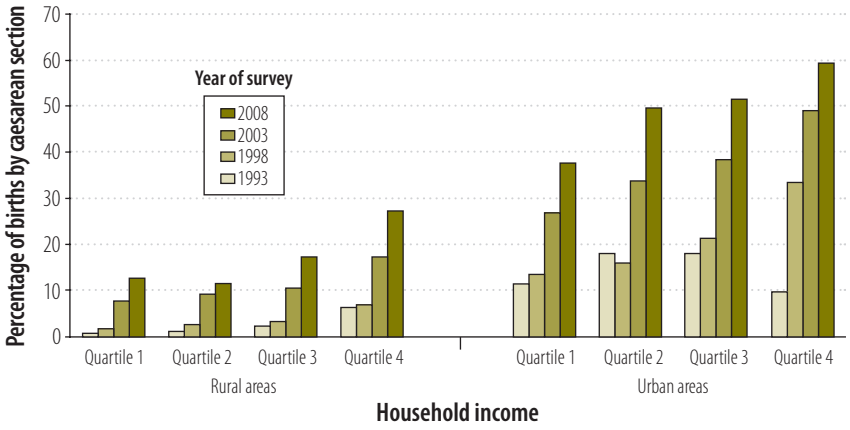
Table 4 shows the change in the caesarean section rate between the 1993 and 2008 surveys in urban and rural areas by household income, access to health insurance and women's educational attainment and parity.

Fig. 2 illustrates the change in caesarean section rate between the 1993 and 2008 surveys in urban and rural areas by household income. The rate remained lower in rural than urban areas regardless of income. For example, in the 2008 survey, 27.4% of the richest women in rural areas gave birth by caesarean section compared with 37.7% of the poorest urban women. In urban areas, the rate increased over time at the same pace in all income quartiles (*P*-value for interaction: 0.2234), while in rural areas the rate of increase was much greater in the lowest than the highest quartile (*P*-value for interaction: 0.0026).

Table 4 and Fig. 3 show that women with no health insurance experienced the most dramatic rise in caesarean section rate between the 1993 and 2008 surveys in both urban and rural areas (*P*-value for interaction: < 0.0001 for both). By 2008, the rate was above 50% for both insured and uninsured urban women. In rural areas, the rate in 2008 was high in women both with and without health insurance: 23.3% and 27.1%, respectively.

Table 4 and Fig. 4 show that the effect of the mother's educational attainment on the change in the caesarean section rate between the 1993 and 2008 surveys was very similar to that of income. We pooled women with no or only primary school education in urban areas and women with secondary and college education in rural areas to increase the power of the statistical

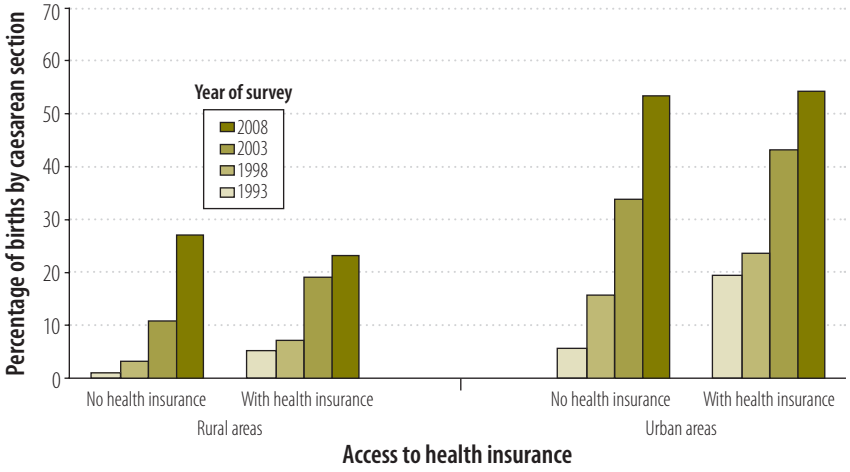
Fig. 2. **Caesarean section rate in rural and urban China, 1988–2008, by household income[a]**



[a] Household income was the per capita annual income, defined as the gross household income divided by the number of individuals in the household, adjusted to 2008 values using separate annual consumer price indices for urban and rural areas. Subsequently, respondents were divided into household income quartiles in rural and urban areas separately.

The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.

Fig. 3. **Caesarean section rate in rural and urban China, 1988–2008, by access to health insurance**



The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.

analysis. By 2008, caesarean section was very common in all educational groups in urban areas (range: 43.9–64.8%). In rural areas, the rate increased much more in women with no education than in those with secondary or higher education (*P*-value for interaction: 0.0034). However, the rate among rural women educated to secondary level or above was only 35.2%, lower than the 43.9% among urban women with no or only primary school education.

Table 4 and Fig. 5 show that women with a parity of two or more experienced the fasted rise in caesarean section rate between the 1993 and 2008 surveys. The rate increased from 0.8% in 1993 to 16.6% in 2008 in rural areas and from 5.9% to 36.4% in urban areas. The rise among women with a first pregnancy was also dramatic: in the 2008 survey, 28.2% of rural primiparous women and 57.1% of urban primiparous women reported giving birth by caesarean section.

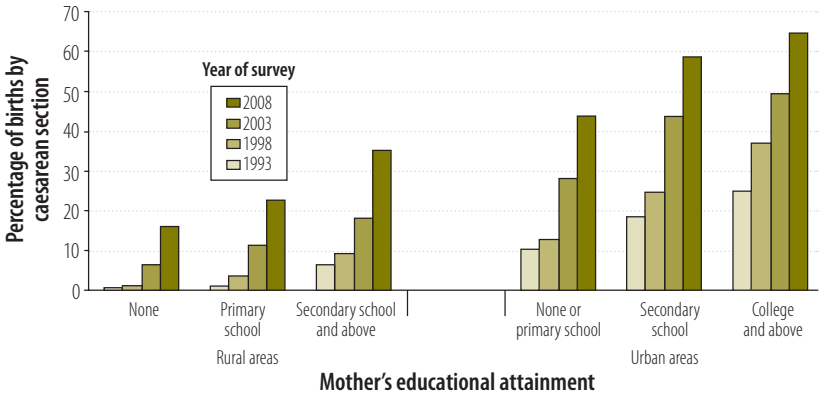
Discussion

Our study confirms that the proportion of births by caesarean section in China rose dramatically between 1988 and 2008. Although the procedure was more common among wealthy and well educated women, the rate increased alarmingly in all socioeconomic groups, including the poor, the uneducated and the rural population. In urban areas in 2008, the rate was over 40% even in poorly educated women. Only the poorest rural women and those living in the most remote and socioeconomically deprived rural type-IV region still had rates below 15%.

Two findings in this study merit particular attention. First, our data suggest that the socioeconomic region of residence is a more important determinant of the caesarean section rate than the women's individual socioeconomic characteristics. For example, the rate was much higher in urban women with a low level of education than in similarly educated rural women. Moreover, in 2008, the rate was almost five times higher among women in the wealthiest rural type-I region than in the poorest rural type-IV region, irrespective of individual variations in household income, educational attainment or access to health insurance. Hence, supply side factors may be a more important determinant of caesarean section than ability to pay or educational level.

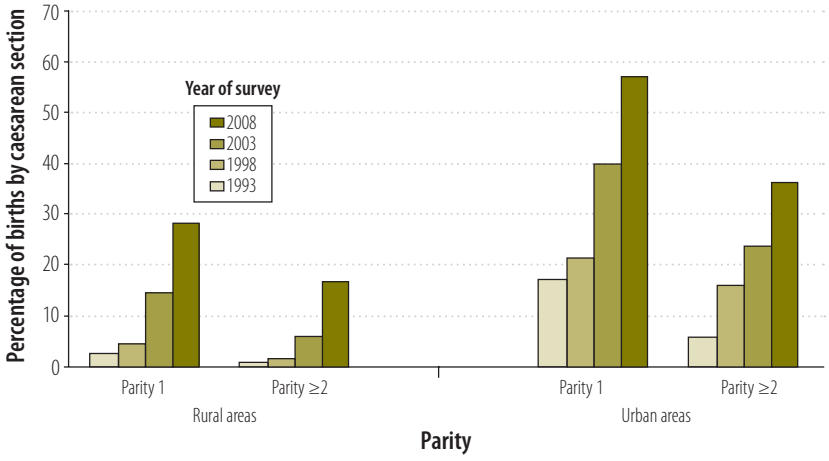
Second, the rise in the caesarean section rate in rural areas of China is only partly accounted for by changes in household income or access to health insurance and the rise in urban areas cannot be attributed to the substantial improvements in income and education over the last two decades. Moreover, the suggested link with health insurance funding[6,10,13,14,18] is called into question by the observation that the rate increased more rapidly among women without health insurance than among those with insurance in both urban and rural areas. This finding is surprising since other researchers have proposed that the increased use of caesarean section was partly driven by the heavy dependence of hospitals on fee-for-service financing and associated profit-related bonus payments for service providers.[8,10,13,14,24] In this context, one would expect higher revenue from

Fig. 4. **Caesarean section rate in rural and urban China, 1988–2008, by mother's education**



The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.

Fig. 5. **Caesarean section rate in rural and urban China, 1988–2008,[a] by parity**



The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.

high-income households[8,9,14,24] and insurance payments[13,14,18] to explain a large part of the increase.

Studies from across the world have shown that the caesarean section rate may be influenced by factors other than the ability to pay, including fear of litigation, convenience, perceived safety, fear of substandard care and the opportunity for sterilization.[2–4,25–27] China's urban caesarean section rate was already high 20 years ago[8,18] and the increasing trend may have been set long before the introduction of financial reforms in the health sector. The introduction of the one-child policy in 1979 may have contributed indirectly to the rise because the medical risk is lower when there are fewer repeat caesarean sections and parents who expect to have only one child may opt for what is perceived to be the safest delivery option. This is reflected in the higher rates we observed among primiparous women. The Chinese Government's emphasis on deliveries attended by doctors rather than midwives may also have contributed. In its modernization, China has marginalized midwifery[28] and the density of nurses and midwives is lower than expected for the country's income level.[29] Midwifery education was discontinued in 1993 and the number of doctors trained in western medicine doubled in the last two decades.[28,30] Hospitals in urban and wealthier regions are better equipped and have more qualified staff than those in more remote rural regions, making caesarean section more accessible. However, the recent focus on strengthening the medical capacity of more remote township hospitals, including assigning obstetrical experts from provincial tertiary hospitals, has also driven up the use of caesarean section in these hospitals.[9,21]

As has been shown in Brazil, once a certain threshold has been reached, caesarean section is increasingly regarded as harmless and effective by both doctors and women. Moreover, poor women, inspired by trends among the rich, increasingly demand caesarean section.[4] Whether Chinese women request caesarean section or are persuaded by their doctors to accept the procedure is not known. Hospital records indicate that a high proportion of caesarean sections are performed for no specific clinical indication,[15–17,24] for social reasons[15–17] or on the women's request,[10,12] but these records need to be interpreted with caution since the power imbalance during labour and delivery favours decision-making by physicians.[26,31]

The data and analytical approach used in this study merit careful scrutiny. Interviews were performed by trained health personnel and bias in self-reported caesarean section is likely to be minimal.[32] In contrast, births may have been underreported, particularly when the pregnancy was not approved by the family planning system or occurred among rural migrants temporarily away from home. Since rural migrants may be less likely to use formal health services, we may have overestimated the proportion of births by caesarean section. Our findings accord with those obtained using different sampling methods however.[10–12,18,33] We categorized income levels in rural and urban areas separately because similar levels of income represent different levels of purchasing power in the two areas. Since the richest rural households had a lower income than the poorest urban households, ignoring the difference between urban and rural areas would have categorized both groups as poor. Income was adjusted to 2008 values because inflation has been substantial in China over the past 20 years.[34] Rural health insurance schemes are decentralized in China[13] and our definition of health insurance may not have captured the variation in

the content or coverage of the different schemes, particularly after 2003 when the New Cooperative Medical System was introduced.[13] Since any misclassification of health insurance is unlikely to be related to the caesarean section rate, we may have underestimated the strength of the association between health insurance and caesarean section. Lastly, we used a Poisson regression approach with robust standard errors to compute RRs when comparing the various groups. This approach is recommended in preference to logistic regression when the outcome is common as odds ratios tend to overestimate the relative risk in this situation.[22,23]

Most previous studies in China and elsewhere have focused on individual determinants of the caesarean section rate at one point in time and have seldom taken into account geographical variation beyond rural–urban disparities.[2,5,6,14,18] Our analysis of the factors responsible for the increasing use of the procedure over time suggests that changes in single variables, such as access to health insurance or increasing wealth, do not explain the rising rate. The strong regional variation in the caesarean section rate we observed, which was independent of socioeconomic changes, points to structural factors related to the supply of services as an important driver of the increase. As hospital delivery becomes nearly universal,[35] women may share knowledge about the risks and benefits of caesarean section and a societal consensus may be reached that the procedure is safe and benefits both mother and child. Very little is known about the actual or perceived safety of caesarean section in China,[7,36] however, and such information is urgently needed. ■

Acknowledgements

We thank Dr Keqin Rao at the Statistics and Information Centre, Ministry of Health of China, Dr Yaoguang Zhang and the China Medical Board. Xing Lin Feng was funded by the China Medical Board through a faculty development programme to study at the London School of Hygiene and Tropical Medicine.

Competing interests: None declared.

ملخص

العوامل المؤثرة في زيادة معدلات الجراحة القيصرية في الصين بين عامي 1988 و 2008

الغرض التعرف على العوامل المؤدية إلى الزيادة السريعة في جراحة القيصرية في الصين بين عامي 1988 و 2008

الطريقة استخدمت المعطيات من أربعة مسوحات وطنية مستعرضة (للأعوام 1993، 1998، 2003، 2008) واستخدم التحوّف المعَدَّل لبواسون لتحديد ما إذا كانت التغيرات في دخل الأسرة، أو الحصول على التأمين الصحي، أو تعليم المرأة قد أثرت على زيادة جراحة القيصرية في المدن والأرياف.

النتائج في عام 2008، أبلغت 64.1٪ من النساء في المدن و 11.3٪ من النساء في المناطق الأشد فقراً في المدن عن ولادتهن بالقيصرية. وكان هناك زيادة سريعة في القيصرية في جميع الفئات الاجتماعية الاقتصادية. وبين عامي 1993 و 2008، زاد خطر الجراحة القيصرية لأكثر من ثلاثة أضعاف في المدن (الخطر النسبي: 3.63؛ فاصلة الثقة 95٪: 2.61–5.04) وأكثر من 15 ضعفاً في الأرياف (الخطر النسبي: 15.46؛ فاصلة الثقة 95٪: 10.46–22.86). وبعد تصحيح التحسن في الدخل والتعليم والحصول على التأمين الصحي طوال مدة الدراسة، انخفض الخطر النسبي في المدن (الخطر النسبي: 3.07؛ فاصلة الثقة 95٪: 2.32–4.07)، وهذا يشير إلى أن هذه العوامل لا تبرر تلك الزيادة؛ أما في الأرياف، فقد انخفض الخطر النسبي المصَحَح إلى 7.18 (فاصلة الثقة 95٪: 4.82–10.69)، وبهذا يظهر أن التغير الاجتماعي الاقتصادي هو المسؤول الوحيد جزئياً عن هذه الزيادة. وكانت منطقة السكن ومستواها الاجتماعي الاقتصادي أكثر أهمية في التأثير على معدل الجراحات القيصرية مقابل الحالة الاجتماعية الاقتصادية للفرد.

الاستنتاج الاختلاف الشاسع بين معدلات الجراحة القيصرية بحسب المنطقة الاجتماعية الاقتصادية، مستقلا عن دخل الفرد أو التأمين الصحي أو التعليم، يدل على أن العوامل البنائية المتعلقة بإمداد الخدمات قد أثرت على زيادة معدل القيصرية أكثر من قدرة المرأة على دفع التكاليف.

摘要

1988--2008年间影响中国剖宫产率上升的因素

目的 旨在确定1988-2008年间推动中国剖宫产迅速上升的因素。

方法 利用四项国家横断面调查数据(1993、1998、2003和2008年)和改良的泊松回归来确定家庭收入、医疗保险的覆盖情况或妇女受教育程度的变化是否为城乡剖宫产上升的原因。

结果 2008年,64.1%的城市妇女和11.3%最贫困农村地区的妇女采用剖宫产分娩。所有社会经济人群中的剖宫产率均快速上升。1993-2008年间,城市地区的剖宫产风险增加了3倍多(相对危险度,3.63;95%可信区间,2.61-5.04),而农村地区则增加了15倍多(相对危险度,15.46;95%可信区间,10.46-22.86)。对妇女在研究阶段的家庭收入、受教育程度和医疗保险的覆盖情况进行调整之后,城市地区的相对风险仅略微降低(相对危险度,3.07;95%可信区间:2.32-4.07),表明这些因素并不能解释剖宫产率的上升;而在农村地区,调整后的相对风险下降到7.18(95%可信区间:4.82-10.69),表明个人社会经济状况的变化只能部分解释这种上升现象。与个人社会经济状况相比,居住的社会经济地区是更为重要的影响剖宫产率的因素。

结论 剖宫产率不受妇女的个人收入、医疗保险或受教育程度的影响,而是随她们所在的社会经济地区域的不同而发生较大变化,这表明相比妇女的支付能力,与提供服务相关的结构因素更多地影响着剖宫产的增长率。

Résumé

Facteurs influençant la hausse des taux de césarienne en Chine entre 1988 et 2008

Objectif Identifier les facteurs de l'augmentation rapide du nombre de césariennes en Chine entre 1988 et 2008.

Méthodes Les données de quatre enquêtes nationales transversales (1993, 1998, 2003 et 2008) et une régression modifiée de Poisson ont été utilisées pour déterminer si des changements dans le revenu des ménages, dans l'accès à l'assurance maladie ou dans l'éducation des femmes expliquaient la hausse du nombre de césariennes dans les zones urbaines et rurales.

Résultats En 2008, 64,1% des citadines et 11,3% des femmes des régions rurales les plus pauvres ont déclaré avoir donné naissance par césarienne. Une hausse accélérée s'est produite dans tous les groupes socioéconomiques. Entre 1993 et 2008, le risque de césarienne a plus que triplé dans les zones urbaines (risque relatif, RR: 3,63, intervalle de confiance de 95%, IC: 2,61–5,04) et a été multiplié par 15 dans les zones rurales (RR: 15,46, IC de 95%: 10,46–22,86). Après ajustement pour améliorations de revenu, d'éducation et d'accès à l'assurance maladie au cours de la période d'étude, le RR a peu chuté dans les zones urbaines (RR: 3,07, IC de 95%: 2,32–4,07), ce qui suggère que ces facteurs n'expliquent pas l'augmentation. Dans les zones rurales, le RR ajusté a chuté à 7,18 (IC de 95%: 4,82–10,69), ce qui montre que l'évolution socioéconomique n'est que partiellement responsable de la hausse. La région socioéconomique de résidence a plus influencé le taux de césarienne que le statut socioéconomique individuel.

Conclusion La grande variation du taux de césarienne par région socioéconomique, indépendamment du revenu individuel, de l'assurance maladie ou de l'éducation, suggère que des facteurs structurels liés à la fourniture de services ont influencé la hausse du taux, plus que la capacité de paiement de la femme.

Резюме

Факторы, повлиявшие на рост числа родоразрешений с использованием кесарева сечения в Китае в 1988–2008 годах

Цель Выявить факторы, приведшие к резкому росту использования кесарева сечения в Китае в 1988–2008 годах.

Методы Чтобы определить, содействовало ли изменение доходов домохозяйств, доступности медицинского страхования или образовательного уровня женщин повышению числа родоразрешений с использованием кесарева сечения в городских и сельских районах, были использованы данные четырех национальных кросс-секционных исследований и модифицированная пуассонова регрессия.

Результаты В 2008 году 64,1% городских женщин и 11,3% женщин в беднейшем сельском регионе сообщили, что рожали с использованием кесарева сечения. Быстрый рост происходил во всех социально-экономических группах. В период с 1993 по 2008 год риск применения кесарева сечения в городских районах возрос более чем в три раза (относительный риск, ОР: 3,63; 95% доверительный интервал, ДИ: 2,61–5,04) а в сельских – более чем в 15 раз (ОР: 15,46; 95% ДИ: 10,46–22,86). После корректировки с учетом увеличения доходов, повышения образовательного уровня и улучшения доступа к медицинскому страхованию за обследуемый период, ОР в городских районах снизился минимально (ОР: 3,07; 95% ДИ: 2,32–4,07); это свидетельствует о том, что рост не объясняется указанными факторами. В сельских районах скорректированный ОР сократился до 7,18 (95% ДИ: 4,82–10,69); это показывает, что социально-экономические перемены лишь частично объясняют рост. Социально-экономический регион проживания был более важным фактором, объясняющим динамику показателя родоразрешений с использованием кесарева сечения, чем индивидуальный социально-экономический статус.

Вывод Значительный разброс показателя родоразрешений с использованием кесарева сечения, не зависящий от индивидуального дохода, медицинского страхования или образования, позволяет предположить, что на рост показателя в большей степени влияли структурные факторы, связанные с предложением услуг, чем платежеспособность женщин.

Resumen

Factores que influyeron en el aumento de la tasa de cesárea en China entre 1988 y 2008

Objetivo Identificar los factores que propiciaron un rápido incremento de las cesáreas en China entre 1988 y 2008.

Métodos Se utilizaron datos procedentes de cuatro encuestas transversales (1993, 1998, 2003 y 2008), así como la regresión de Poisson modificada para determinar si los cambios en los ingresos familiares, el acceso al seguro sanitario o la educación de las mujeres contribuyeron al aumento de las cesáreas en áreas urbanas y rurales.

Resultados En 2008 se informó de que el 64,1% de las mujeres residentes en áreas urbanas y el 11,3% de las mujeres residentes en áreas rurales dieron a luz mediante cesárea. Se produjo un rápido incremento en todos los grupos socioeconómicos. Entre 1993 y 2008, el riesgo de dar a luz mediante cesárea aumentó más de tres veces en áreas urbanas (riesgo relativo, RR: 3,63; 95% intervalo de confianza, IC: 2,61–5,04) y más de 15 veces en áreas rurales (RR: 15,46; 95% IC: 10,46–22,86). Después del ajuste de las mejoras en los ingresos, educación y acceso al seguro sanitario durante el periodo de estudio, el RR registró una reducción mínima en las áreas urbanas (RR: 3,07; 95% IC: 2,32–4,07), lo que sugiere que estos factores no explican el aumento; en áreas rurales el RR ajustado se redujo hasta 7,18 (95% IC: 4,82–10,69), lo que demuestra que el cambio socioeconómico solo es parcialmente responsable del aumento. La región socioeconómica de residencia fue un impulsor más importante que el estatus socioeconómico individual para el aumento de la tasa de cesárea.

Conclusión La gran variación en la tasa de cesárea por región socioeconómica, independientemente de los ingresos individuales, del seguro sanitario o de la educación, sugiere que los factores estructurales relacionados con el suministro de servicios han influido más en el aumento de dicha tasa que la solvencia de las mujeres.

References

1. Betrán AP, Merialdi M, Lauer JA, Bing-Shun W, Thomas J, Van Look P et al. Rates of caesarean section: analysis of global, regional and national estimates. *Paediatr Perinat Epidemiol* 2007;21:98–113. doi:10.1111/j.1365-3016.2007.00786.x PMID:17302638
2. Leone T, Padmadas SS, Matthews Z. Community factors affecting rising caesarean section rates in developing countries: an analysis of six countries. *Soc Sci Med* 2008;67:1236–46. doi:10.1016/j.socscimed.2008.06.032 PMID:18657345
3. Barros FC, Victora CE, Vaughan JP, Huttly SRA. Epidemic of caesarean sections in Brazil. *Lancet* 1991;338:167–9. doi:10.1016/0140-6736(91)90149-J PMID:1677075
4. Victora CG, Barros FC. Beware: unnecessary caesarean sections may be hazardous. *Lancet* 2006;367:1796–7. doi:10.1016/S0140-6736(06)68780-1 PMID:16753467
5. Belizán JM, Althabe F, Barros FC, Alexander S. Rates and implications of caesarean sections in Latin America: ecological study. *BMJ* 1999;319:1397–400. doi:10.1136/bmj.319.7222.1397 PMID:10574855
6. Murray SF. Relation between private health insurance and high rates of caesarean section in Chile: qualitative and quantitative study. *BMJ* 2000;321:1501–5. doi:10.1136/bmj.321.7275.1501 PMID:11118176
7. Lumbiganon P, Laopaiboon M, Gulmezoglu AM, Souza JP, Taneepanichskul S, Ruyan P et al. Method of delivery and pregnancy outcomes in Asia: the WHO global survey on maternal and perinatal health 2007-08. *Lancet* 2010;375:490–9. doi:10.1016/S0140-6736(09)61870-5 PMID:20071021
8. Tang S, Li X, Wu Z. Rising cesarean delivery rate in primiparous women in urban China: evidence from three nationwide household health surveys. *Am J Obstet Gynecol* 2006;195:1527–32. doi:10.1016/j.ajog.2006.03.044 PMID:16677593
9. Klemetti R, Che X, Gao Y, Raven J, Wu Z, Tang S et al. Cesarean section delivery among primiparous women in rural China: an emerging epidemic. *Am J Obstet Gynecol* 2010;202:65.e1-6. doi:10.1016/j.ajog.2009.08.032 PMID:19819416
10. Hong X. Factors related to the high cesarean section rate and their effects on the "price transparency policy" in Beijing, China. *Tohoku J Exp Med* 2007;212:283–98. doi:10.1620/tjem.212.283 PMID:17592216
11. Han W, Song J, Liu A, Huo K, Xu F, Cui S et al. Trends in live births in the past 20 years in Zhengzhou, China. *Acta Obstet Gynecol Scand* 2011;90:332–7. doi:10.1111/j.1600-0412.2010.01065.x PMID:21306327
12. Zhang J, Liu Y, Meikle S, Zheng J, Sun W, Li Z. Cesarean delivery on maternal request in southeast China. *Obstet Gynecol* 2008;111:1077–82. doi:10.1097/AOG.0b013e31816e349e PMID:18448738
13. Bogg L, Huang K, Long Q, Shen Y, Hemminki E. Dramatic increase of Cesarean deliveries in the midst of health reforms in rural China. *Soc Sci Med* 2010;70:1544–9. doi:10.1016/j.socscimed.2010.01.026 PMID:20219278
14. Long Q, Zhang Y, Raven J, Wu Z, Bogg L, Tang S et al. Giving birth at a health-care facility in rural China: is it affordable for the poor? *Bull World Health Organ* 2011;89:144–52. doi:10.2471/BLT.10.079434 PMID:21346926
15. Du X, Chen YZ, Lei YL. Indication changes of caesarean section. *Chin J Reprod Health* 2004;15:218–20. In Chinese
16. Huang PQ, Li GY, Chen WY, Wang G, Zhang Y. The changing rate and indications of caesarean section over 12 years. *Acad J Guangzhou Med Coll* 2004;32:57–9. In Chinese
17. Feng L, Yue Y. Analysis on the 45-year cesarean rate and its social factors. *Med Soc* 2002;15:14–6. In Chinese
18. Cai WW, Marks JS, Chen CH, Zhuang YX, Morris L, Harris JR. Increased cesarean section rates and emerging patterns of health insurance in Shanghai, China. *Am J Public Health* 1998;88:777–80. doi:10.2105/AJPH.88.5.777 PMID:9585744
19. Yip WC, Hsiao W, Meng Q, Chen W, Sun X. Realignment of incentives for health-care providers in China. *Lancet* 2010;375:1120–30. doi:10.1016/S0140-6736(10)60063-3 PMID:20346818
20. Kaufman J, Jing F. Privatisation of health services and the reproductive health of rural Chinese women. *Reprod Health Matters* 2002;10:108–16. doi:10.1016/S0968-8080(02)00090-3 PMID:12557647
21. *The guideline manual for the Fourth National Health Services Survey*. Beijing: Ministry of Health; 2008. In Chinese.
22. Schmidt CO, Kohlmann T. When to use the odds ratio or the relative risk? *Int J Public Health* 2008;53:165–7. doi:10.1007/s00038-008-7068-3 PMID:19127890
23. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004;159:702–6. doi:10.1093/aje/kwh090 PMID:15033648
24. Harris A, Gao Y, Barclay L, Belton S, Yue ZW, Min H et al. Consequences of birth policies and practices in post-reform China. *Reprod Health Matters* 2007;15:114–24. doi:10.1016/S0968-8080(07)30315-7 PMID:17938076
25. Wagner M. Choosing caesarean section. *Lancet* 2000;356:1677–80. doi:10.1016/S0140-6736(00)03169-X PMID:11089840
26. Béhague DP, Victora CG, Barros FC. Consumer demand for caesarean sections in Brazil: informed decision-making, patient choice, or social inequality? A population based birth cohort study linking ethnographic and epidemiological methods. *BMJ* 2002;324:942–5. doi:10.1136/bmj.324.7343.942 PMID:11964338
27. Mazzoni A, Althabe F, Liu NH, Bonotti AM, Gibbons L, Sánchez AJ et al. Women's preferences for caesarean section: a systematic review and meta-analysis of observational studies. *BJOG* 2011;118:391–9. doi:10.1111/j.1471-0528.2010.02793.x PMID:21134103
28. Anand S, Fan VY, Zhang J, Zhang L, Ke Y, Dong Z et al. China's human resources for health: quantity, quality, and distribution. *Lancet* 2008;372:1774–81. doi:10.1016/S0140-6736(08)61363-X PMID:18930528
29. Cheung NF. Chinese midwifery: the history and modernity. *Midwifery* 2009;25:228–41. doi:10.1016/j.midw.2007.03.001 PMID:17600600
30. Chen ZM, Godfrey R. Being a doctor in China. *Lancet* 1991;338:169–72. doi:10.1016/0140-6736(91)90150-N PMID:1677076
31. Gamble J, Creedy DK, McCourt C, Weaver J, Beake S. A critique of the literature on women's request for cesarean section. *Birth* 2007;34:331–40. doi:10.1111/j.1523-536X.2007.00193.x PMID:18021149
32. Stanton CK, Dubourg D, de Brouwere V, Pujades M, Ronsmans C. Reliability of data on caesarean sections in developing countries. *Bull World Health Organ* 2005;83:449–55. PMID:15976896
33. Sufang G, Padmadas SS, Zhao F, Brown JJ, Stones RW. Delivery settings and caesarean section rates in China. *Bull World Health Organ* 2007;85:755–62. doi:10.2471/BLT.06.035808 PMID:18038056
34. Knight J. Reform, growth, and inequality in China. *Asian Econ Policy Rev* 2008;3:140–58. doi:10.1111/j.1748-3131.2008.00099.x
35. Feng XL, Ling L, Guo Y, Ronsmans C. Trends in hospital births in China between 1988 and 2008. *Bull World Health Organ* 2011;89:432–41. doi:10.2471/BLT.10.085274 PMID:21673859
36. Wang BS, Zhou LF, Coulter D, Liang H, Zhong Y, Guo YN et al. Effects of caesarean section on maternal health in low risk nulliparous women: a prospective matched cohort study in Shanghai, China. *BMC Pregnancy Childbirth* 2010;10:78. doi:10.1186/1471-2393-10-78 PMID:21122153

Table 1. **Characteristics of women giving birth in urban and rural China, 1988–2008**

Characteristic	Live births in 1993 survey		Live births in 1998 survey		Live births in 2003 survey		Live births in 2008 survey	
	No.	%	No.	%	No.	%	No.	%
Urban areas								
Household income[a,b]								
Quartile 1	1 005	40.8	179	24.4	310	20.4	106	9.5
Quartile 2	861	35.8	197	28.3	431	24.0	187	13.2
Quartile 3	389	17.8	211	29.7	531	28.1	382	26.6
Quartile 4	97	5.4	112	17.2	589	27.4	798	51.4
Health insurance								
No	805	33.7	380	49.2	964	57.9	502	35.9
Yes	1 549	66.3	322	50.7	899	42.1	976	64.1
Mother's education[c]								
None	155	3.4	29	1.9	48	1.0	30	1.2
Primary school	1 065	49.4	301	54.8	741	44.8	532	40.0
Secondary school	883	37.0	252	29.1	628	33.0	484	32.5
College and above	244	9.8	115	13.5	445	21.2	430	26.3
Parity[d]								
1	1 877	78.5	634	87.6	1 628	85.7	1 208	80.4
2	354	15.8	57	10.8	210	12.6	232	17.3
≥ 3	122	5.6	11	1.6	25	1.7	32	2.1
Rural areas								
Household income[a,e]								
Quartile 1	4 910	38.0	513	10.8	1 375	17.0	235	2.4
Quartile 2	3 764	35.2	1 033	30.8	1 790	23.8	487	6.0
Quartile 3	2 003	19.8	1 093	35.7	2 257	32.9	1 606	24.1
Quartile 4	681	6.9	636	22.7	1 750	26.3	3 955	67.4
Health insurance								
No	10 090	87.0	3 056	92.6	6 239	88.5	475	8.0
Yes	1 283	13.0	220	7.4	935	11.5	5 815	92.0
Mother's education[f]								
None	2 882	22.9	573	11.3	905	9.9	471	5.7
Primary school	7 869	71.3	2 497	82.0	5 755	83.1	5 202	84.0
Secondary school	570	5.3	156	5.1	433	6.0	518	8.7
College and above	32	0.3	15	0.5	76	1.0	96	1.5
Parity[g]								
1	4 072	37.7	2 118	68.3	3 870	56.2	3 228	50.5
2	4 111	37.0	865	26.0	2 612	36.1	2 567	42.7
≥ 3	3 180	25.2	293	5.7	692	7.6	478	6.5

[a] Household income was the per capita annual income, defined as the gross household income divided by the number of individuals in the household, adjusted to 2008 values using separate annual consumer price indices for urban and rural areas. Subsequently, respondents were divided into household income quartiles in rural and urban areas separately.
[b] Income data were missing for 12 births in urban areas.
[c] Information on the mother's education was missing for 15 births in urban areas.
[d] Information on parity was missing for 7 births in urban areas.
[e] Income data were missing for 25 births in rural areas.
[f] Information on the mother's education was missing for 63 births in rural areas.
[g] Information on parity was missing for 27 births in rural areas.
The data were obtained from four cross-sectional National Health Service Surveys carried out in China in 1993, 1998, 2003 and 2008.