

# BMJ Open Factors contributing to the rapid rise of caesarean section: a prospective study of primiparous Chinese women in Shanghai

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## ABSTRACT

**Objective:** To identify factors contributing to the rapid rise of caesarean section in Shanghai through the prospective observation of changes in the preferred mode of delivery in pregnancy among primiparous Chinese women.

**Design:** Prospective study.

**Setting:** Two general hospitals in Shanghai.

**Participants:** A cohort of 832 low-risk primiparous women participated in the investigation from 2010–2012 three consecutive times, from their second to third trimester and, finally, 1–2 days post partum.

**Methods:** Participants were interviewed, using standard questionnaires, for information on demographic characteristics, maternal childbirth self-efficacy, their preference of delivery mode before childbirth and on the people most influential to them when making decisions on delivery mode. Caesarean section indications in the medical records were extracted by the investigators and assessed against clinical guidelines. Caesarean sections were categorised into three groups: guideline-defined indications, doctor-defined indications and maternal request.

**Main outcome measures:** Preferred mode of delivery; indications for caesarean section; actual mode of delivery; determinants of caesarean section.

**Results:** Of 832 pregnant women enrolled, 13.2% preferred caesarean section in the second trimester. This figure rose to 17.0% in the third trimester among 599 followed women. Of 523 women completing all three interviews, 58.1% underwent caesarean section. However, 34.9% of women undergoing caesarean section did not have any indications listed in the clinical guidelines nor based on maternal request. Multinomial regression analysis showed that doctors' influence was one of the significant risk factors of undergoing caesarean section, with doctor-defined indications. Participants with low maternal childbirth self-efficacy were more likely to request caesarean sections themselves.

**Conclusions:** When deciding to deliver via caesarean section without justified clinical indications in the guideline, Chinese doctors played an important role in decision-making. Among primiparous Chinese women, decisions to use caesarean sections were often made

## Strengths and limitations of this study

- The uniqueness of our paper is in the use of a prospective study following a number of pregnant women from the second trimester of pregnancy via the third trimester to post partum to identify changes in the preferred mode of delivery in women over the course of pregnancy and to understand the determinants of using caesarean sections for child delivery.
- The pregnant women in the study were selected from only two general hospitals located in one district of Shanghai, and might not reflect the situation in the rest of the country, or even that in the greater metropolitan area of Shanghai.
- A big proportion of loss to follow-up occurred among rural-to-urban migrants.

during the third trimester or during the process of labour.

## INTRODUCTION

Caesarean section (CS) is the most commonly performed surgery in obstetrical care. It can be life-saving and is also a highly effective procedure for preventing complications such as dystocia. The WHO stated, in 2015, that every effort should be made to provide CS to women in need, rather than striving to achieve a specific rate.<sup>1</sup> The level of CS rates worldwide varies a great deal. Wylie and Mirza found, from data of 36 developing countries, that the CS rate in the least-developed countries was often <5%. However, CS appeared to be overused in most-developed countries and emerging economies. The CS rate in those countries stood at more than 30%.<sup>2</sup> Other large ecological studies arrived at similar conclusions.<sup>3 4</sup> From 2004 to 2008, the WHO conducted a global survey on maternal and perinatal health with 373 health facilities

selected from 24 countries across Latin America, Africa and Asia.<sup>5</sup> Although the data were not nationally representative, China was reported to have the highest CS rate (46.2%) in the global survey.<sup>6</sup> The other countries ranged from 1.62% (Angola) to 42.0% (Paraguay).<sup>7 8</sup> It is worth noting that, in 23 countries, excluding China, the CS rate without medical indications ranged between 0.01% and 2.10%. In contrast, this figure was 11.6% in China, accounting for 63% of all CS without medical indications for the 24 countries surveyed.<sup>5</sup>

The rise in CS rates in middle-income countries, such as Argentina and Paraguay, has been found to be faster in recent decades than that in high-income countries. According to the global survey, Japan had a CS rate of 19.8% and USA reported a CS rate of 32.8% in 2012.<sup>6 9</sup> The average CS rate of 18 European Union member states was 26.8% in 2011;<sup>10</sup> however, China has experienced an exponential increase in CS since the 1980s.<sup>11–13</sup> From the National Health Service Survey, the overall CS rate has increased rapidly, from 2.35% to 27.2%, between 1993 and 2008. The CS rates in large Chinese cities with populations over 100 million rose from 10.12% to 63.0% between 1993 and 2008.

The WHO global survey found that CS without medical indications increased the risk of adverse short-term outcomes.<sup>5</sup> A secondary analysis of two WHO multicountry surveys showed the importance of avoidance of medically unnecessary primary CS.<sup>14</sup> With the introduction of the two-child policy for only-child parents (a policy that allows couples to have two children if one of the parents is an only child) in 2014, avoidance of medically unnecessary primary CS is of special significance in China. In March 2014, the American College of Obstetricians and Gynecologists, and the Society for Maternal-Fetal Medicine, called for policy changes to safely lower the rate of primary caesarean delivery.<sup>15</sup> This illustrates and supports the need for lowering CS rates at global and at national levels, from a professional perspective.

Researchers have in recent years tried to study factors leading to the rapid increase of CS in China.<sup>13 16–22</sup> The key factors reported included maternal influences of high education and age; provider preference of using CS, overdiagnosis for fetal or maternal risks; and demographic characteristics such as health insurance coverage. Most of the published studies were retrospective, or analysed secondary data or cross-sectional surveys. Given the methodological limitations of these studies, they all failed to understand whether or not these pregnant women wanted CS initially or whether their delivery via CS was due to other factors. Our study aimed to identify factors contributing to the rapid rise of CS in Shanghai through the prospective observation of changes in the preferred mode of delivery (MOD) over the course of pregnancy among primiparous Chinese women. It tried to observe changes in the preference of MOD in different time periods before childbirth, to examine the difference between what was preferred and what actually

happened, and to analyse the determinants of changes in the MOD decisions.

## METHODS

### Design and study settings

We used a prospective design to invite a cohort of pregnant women to participate in the three consecutive surveys: the second, third trimester of the pregnancy and 1–2 days after childbirth. The location of the study was in Shanghai, in one of eight central districts in the city. Only two general hospitals in the district provided delivery services—one is a tertiary hospital and the other is a secondary hospital. Both were included in the study as the research sites.

### Sample size

Many factors can be associated with the high CS rates in China. Unable to use all indicators for sample size calculation, we instead took commonly recognised factors reported in the published literature into account for the study sample size. Two sample sizes were calculated based on the proportion of average monthly income per capita and maternal age,<sup>23 24</sup> these were 312 and 532, respectively (type I error was 0.05 and type II error was 0.1). We chose the larger sample size and expanded it as we hypothesised that approximately 30% of women might withdraw from the study. As a result, we came up with a sample of 760 pregnant women for our study.

### Data collection

In Shanghai, most pregnant women receive all their antenatal care in the same hospital where they plan to give birth. From December 2010 to June 2011, pregnant women from the two hospitals who had met the inclusion criteria were asked if they would be willing to participate in the study during their antenatal check-ups. Finally, 832 eligible participants were enrolled consecutively. The selection criteria included: (1) being a primigravida in the second trimester; (2) having no severe heart, liver, lung, kidney or endocrine diseases, and having no history of mental illness (ie, no red labels of high risk on their medical records) and (3) planning to give birth at either of the hospitals included in the study.

In general, the data were collected two ways: information from self-administered questionnaires, including demographic characteristics and maternal preference of MOD, was obtained, and information from medical records, such as body mass index, number of induced abortions undergone, actual MOD, CS indications and the birth weight of the neonate, was extracted by the trained investigators. The standardised questionnaires were designed by the researchers from the School of Public Health of Fudan University. Assessment of maternal self-efficacy on vaginal childbirth, which is the belief of a pregnant woman in her competence to deliver her baby vaginally, was also included in the questionnaires using a validated Chinese scale.<sup>25</sup> This scale was

developed, with some modifications, from the General Perceived Self-efficacy Scale (GSES, Ralf Schwarzer) and had a Cronbach's  $\alpha$  of 0.81. The scale scored study subjects' confidence in terms of their personal beliefs in their ability to give birth, their behaviour being based on their own decisions, their ability and confidence to cope with difficulties, and their confidence in delivering babies vaginally. The larger the score, the more confidence the women had to deliver their babies vaginally.<sup>25</sup> An online additional file 1 shows the detailed components of the scale.

Nurses at the obstetrical clinics and wards were trained to explain the objectives of the survey questionnaires to the participants, to guide them to finish the self-administered questionnaires and to extract necessary information from medical records. The baseline survey was organised immediately after the enrolment, to obtain personal information, maternal self-efficacy on vaginal childbirth and maternal preference of MOD. In the month prior to the expected due date, the nurses interviewed these women again to understand any changes in preferred MOD. After 1 or 2 postpartum days, the participants were interviewed a third time to obtain information about key factors and determinants related to their actual MOD. One of the items in the third questionnaire to affirm key factors was, 'Who was the most influential person in deciding your MOD?'. It was a single-answer question, and the choices included the 'woman herself', 'doctor', 'husband', 'elder members in the family', 'friends' and 'others'.

#### Adjustment of missing data

Of the 832 eligible participants who enrolled at the initial stage, 599 (72.0%) completed the second interview and 523 (62.9%) completed the third interview. We investigated the demographic characteristics of the 309 missing participants, and found that many of these women had migrated from rural to urban areas, and did not have permanent residence status in Shanghai (data are given in the first paragraph of Results). In order to study the effect of this exited sample, we estimated its CS rate based on migrant women who completed all three interviews, and adjusted the total CS rate to account for the missing data and their potential accompanying bias. We compared the adjusted CS rate with the true observed CS rate.

#### Assessment of clinical indications of CS against the guideline

The study used the national guideline from the 'Clinical Technological Practice Standards—Obstetrics and Gynecology Volume', compiled by the Chinese Medical Association in 2007,<sup>26</sup> to assess if the cases had justified indications for CS. All the CS indications and other information such as estimated birth weight were extracted from medical records as completely as possible. One researcher from Fudan University and one maternal healthcare specialist independently assessed

CS indications, case by case, and discussed the results, using the guideline. If they disagreed with each other, they discussed the disagreements and tried to reach a consensus. If the cases met CS indication criteria, according to the guideline, they were classified as 'guideline-defined indications', while the cases without any medical indications for CS were grouped into 'maternal request'. The remaining cases were classed as 'doctor-defined indications'. For CS with multiple indications, if one indication met the criteria listed in the guideline, the case was deemed as CS with justified indications. Guideline-defined indications mainly comprised of fetal distress, cephalopelvic disproportion, malpresentation and severe pregnancy complications such as eclampsia. However, doctor-defined indications included non-severe pregnancy complications, such as gestational hypertension, oligohydramnios and heavy fetus. The detailed distribution of guideline-defined and doctor-defined indications is shown in online additional file 2. The different modes of delivery were broken down accordingly into (1) vaginal delivery (VD), (2) CS on maternal request, (3) CS with doctor-defined indications and (4) CS with guideline-defined indications.

#### Data management and analysis

The completed questionnaires were coded by the researchers from Fudan University. The data set was established with double-entry checks using EpiData V.3.1. We used SPSS V.16.0 for statistical analysis. One-way analysis of variance, non-parametric and  $\chi^2$  tests were used for univariate analyses. A multinomial logistic regression model was established to analyse the factors associated with CS. The dependent variable in the model was the MOD (1=VD, 2=CS on maternal request, 3=CS with doctor-defined indications and 4=CS with guideline-defined indications). Independent variables included maternal age, residence status, abortion experience, maternal childbirth self-efficacy in the second trimester and the person who most influenced the decision of the MOD. The rationale for choosing these independent variables is described in the Results section.

#### Quality control

All the investigators had received proper training prior to the data collection. Every completed questionnaire was double checked by the investigators themselves as well as by the supervisor (ie, team leader). If key questions were not answered, or answers to these questions were inconsistent or not logical, appropriate actions were taken to make corrections by contacting the women again via phone.

#### Ethical considerations

All eligible pregnant women were informed of the objectives and contents of the study. A written consent form was signed by the women who agreed to participate in the study.

## RESULTS

### Demographic characteristics of participants

A total of 832 pregnant women in their second trimester, from the two hospitals, were enrolled at an average of 18.5 gestational weeks (range: 13.1–27.7); of these women, 599 (72.0%) completed the second interview at an average of 37.1 gestational weeks (range: 32.7–41.0). Of the 832 women, 523 (62.9%) completed all three interviews, including 219 women who delivered vaginally and 304 women who had CS procedures (figure 1). Table 1 presents the 523 participants' demographic characteristics. Age and resident status showed statistical differences among four groups. We found that the pregnant women who did not have permanent residence status in Shanghai or who were unemployed, were more likely to drop out of the study. For the women who were lost to the follow-up interviews, 62.1% did not have Shanghai permanent residence and 29.8% were unemployed. Other characteristics between those lost to follow-up and those who completed the three interviews differed slightly: average age of lost women was 27.0 versus 27.4 for the followed women; 35.3% of lost women versus 31.0% of followed women had induced

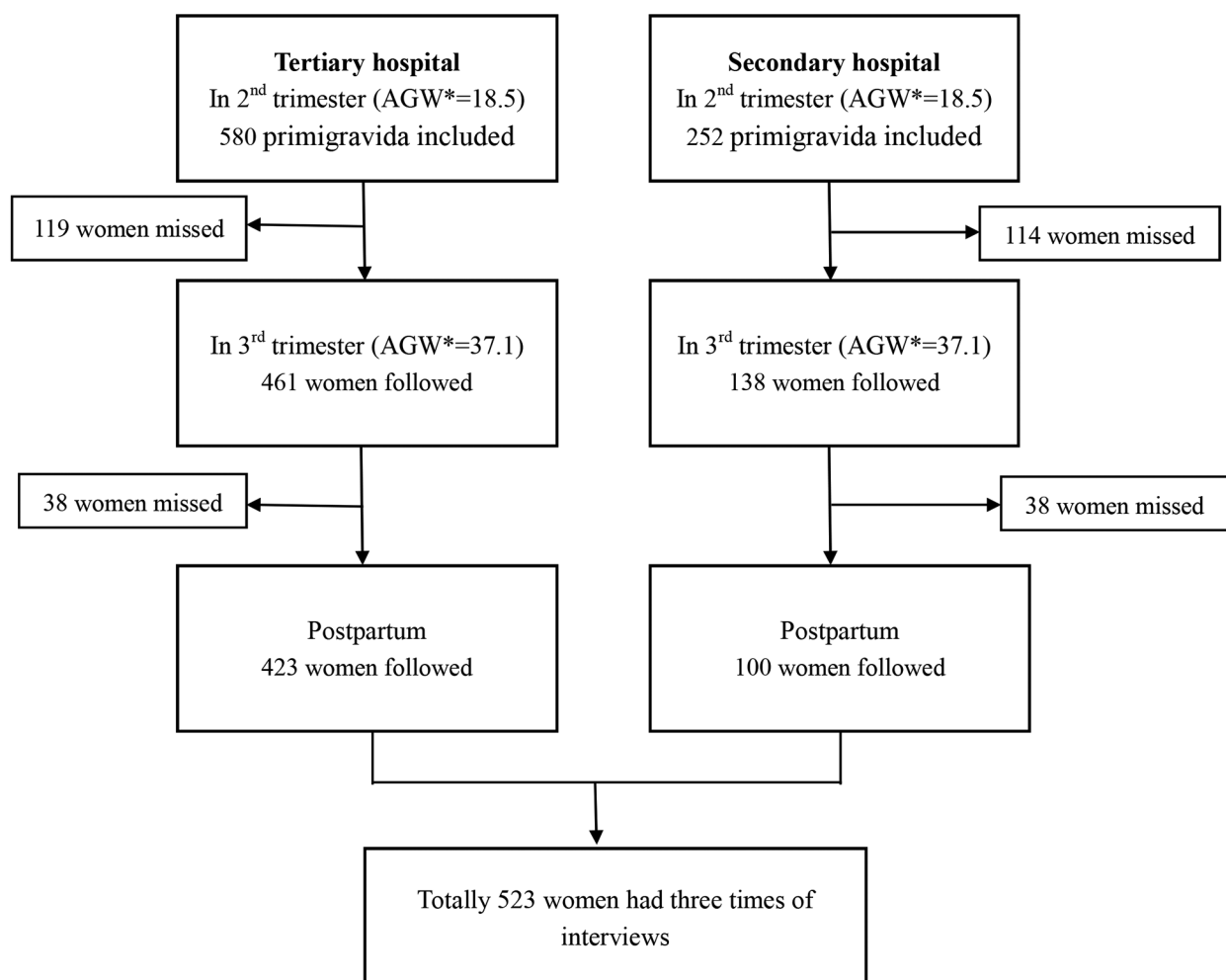
abortion experience; 12.6% of lost women versus 13.4% of followed women preferred CS in the second trimester.

### The consistency of physician's decision on CS against guidelines

As introduced in the Methods section, decisions on the use of CS were assessed, according to the national guideline issued by the Chinese Medical Association. Of 304 women who underwent CS, 15.1% (46) were based on maternal request, 34.9% (106) had CS with doctor-defined indications and 50.0% (152) with guideline-defined indications. Among half of CS that was not decided in line with the guideline, more than two-thirds was decided by doctors and less than one-third of CS was based on maternal request.

### Disparity between maternal preference of MOD and actual MOD

In the second trimester, 13.2% of the 832 women preferred CS, while in the third trimester this figure rose to 17.0% of 599 followed women. And, 58.1% of 523 followed women eventually underwent CS: 8.8% due to



**Figure 1** Flow diagram of the cohort in the study. \*Average gestational weeks.

**Table 1** Demographic characteristics of primiparous women by mode of delivery (N=523)

	VD (N=219)	CS on maternal request (N=46)	CS with doctor-defined indications (N=106)	CS with guideline-defined indications (N=152)	p Value
Age	27.0	27.4	27.1	28.1	0.012*
Residence status (N (%))					0.018†
Shanghai residents (with Shanghai Hukou)	106 (37.2)	33 (11.6)	64 (22.5)	82 (28.8)	
Migrants (without Shanghai Hukou)	112 (47.5)	13 (5.5)	42 (17.8)	69 (29.2)	
Education (N (%))					0.348‡
Junior high school or lower	25 (51.0)	2 (4.1)	9 (18.4)	13 (26.5)	
Senior high school	44 (46.3)	8 (8.4)	19 (20.0)	24 (25.3)	
College level	137 (38.7)	35 (9.9)	76 (21.5)	106 (29.9)	
Master degree or above	10 (45.5)	1 (4.5)	2 (9.1)	9 (40.9)	
Occupation (N (%))					0.881†
Worker in factory/ commercial industry	44 (37.6)	8 (6.8)	27 (23.1)	38 (32.5)	
Private business owner	21 (46.7)	3 (6.7)	7 (15.6)	14 (31.1)	
Government/technical staff	101 (42.6)	21 (8.9)	49 (20.7)	66 (27.8)	
Unemployed	43 (43.9)	12 (12.2)	17 (17.3)	26 (26.5)	
Others	5 (29.4)	2 (11.8)	5 (29.4)	5 (29.4)	
Income§ (¥) (N (%))					0.248‡
<2000	11 (44.0)	4 (16.0)	3 (12.0)	7 (28.0)	
2001–4000	77 (43.8)	7 (4.0)	40 (22.7)	52 (29.5)	
4001–5000	41 (41.0)	8 (8.0)	18 (18.0)	33 (33.0)	
>5000	84 (39.6)	26 (12.3)	43 (20.3)	59 (27.8)	
Childbirth Fees Reimbursement					0.103†
Yes	157 (39.7)	40 (10.1)	78 (19.7)	120 (30.4)	
No	62 (48.4)	6 (4.7)	28 (21.9)	32 (25.0)	
Hospital (N (%))					0.420†
Tertiary	178 (42.1)	38 (9.0)	80 (18.9)	127 (30.0)	
Secondary	41 (41.0)	8 (8.0)	26 (26.0)	25 (25.0)	

\*One-way analysis of variance test.

†Pearson  $\chi^2$  test.

‡Kruskal–Wallis test.

§Average monthly income per capita.

CS, caesarean section; VD, vaginal delivery.

maternal request, 20.3% as a result of doctor-defined indications and 29.1% as a result of guideline-defined indications, as shown in figure 2. We found the adjusted CS preference rate in the third trimester was 15.3% and the adjusted CS rate post partum was 56.2%: 7.6% due to maternal request, 19.4% as a result of doctor-defined indications and 29.2% as a result of guideline-defined indications. The shift of estimated CS rates due to loss of samples was minimal. In other words, we believe the missing data does not exert a discernible bias.

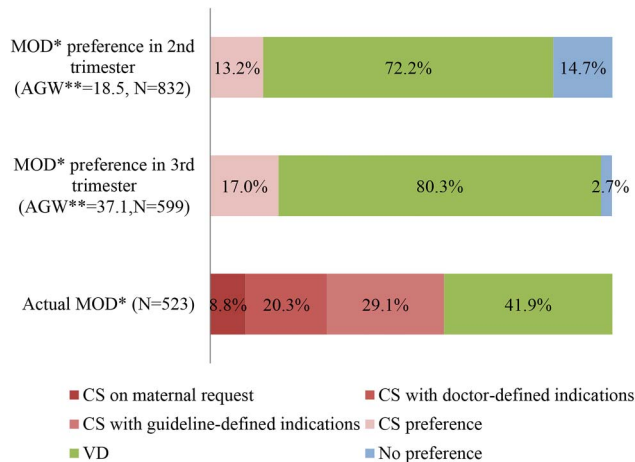
As seen in table 2, of women who preferred VD in the second trimester, 42.9% actually delivered their babies vaginally. For those women who preferred VD in the third trimester, 48.1% delivered vaginally. In comparison, 72.9% of women who preferred CS in the second trimester and 83.5% in the third trimester actually underwent CS. Such differences indicate that prenatal CS preference was more closely correlated with actual MOD than VD preference.

### Changes in maternal self-efficacy between the second and third trimester

As seen in table 3, the women who opted for CS based on maternal request had the lowest maternal self-efficacy score in both the second and third trimester among the four groups. A difference in self-efficacy scores between the second and third trimester was only found in the group of women having CS with doctor-defined indications.

### Analysis of factors contributing to CS rates

A multinomial logistic regression model was used to analyse factors associated with CS. Among the demographic characteristics of participants we investigated in the study, only age and resident status showed statistical differences (table 1). Education, family income and reimbursement of health service expenses were all highly correlated with the variable of resident status. Thus, we chose only age and resident status in the



**Figure 2** Comparison between actual mode of delivery and maternal preference of mode of delivery prior to childbirth. The actual mode of delivery was divided into four groups: caesarean section on maternal request, caesarean section with doctor-defined indications, caesarean section with guideline-defined indications and vaginal delivery. \*Mode of delivery (MOD). \*\*Average gestational weeks (AGW).

model. Maternal self-efficacy in the second trimester was less likely to be influenced by service providers or self-perceived health status; thus, we included maternal self-efficacy in the second trimester, instead of the third, in the model. This was also the same reason why we only included the maternal MOD preference in the second trimester, and not in the third trimester. Since most participants chose the ‘woman herself’ and ‘doctor’ as the most influential person in the postpartum interview, we combined the groups of husband, elder members in the family and friends, into the group of others. The largest variance inflation factor of the variables included in the model was 1.948, indicating the collinearity of these variables was not severe.

As seen in table 4, maternal childbirth self-efficacy in the second trimester affected CS on maternal request. Along with increases in self-efficacy score, the likelihood of VD increased 1.18 (1/0.845) times compared to CS on maternal request. Maternal preference of CS was only associated with CS on maternal request. Doctor’s suggestion on CS decision had an impact on CS with doctor-defined indications and CS with guideline-defined indications. It appeared to show that doctor’s suggestion increased CS with doctor-defined indications and CS with guideline-defined indications but did not influence CS on maternal request. Shanghai residence was a risk factor for CS on maternal request and CS with doctor-defined indications. Abortion experience was another risk factor for only CS with doctor-defined indications. Maternal age was only associated with CS with guideline-defined indications.

## DISCUSSION

The study presented is likely one of the few using a prospective study design to explore factors contributing to the high CS rates among primiparous women in China. One key finding from the study was that most women did not initially want to undergo CS for their delivery but ended up delivering via CS. The changes often took place over 32 gestational weeks and during the process of labour. Doctor’s advice on CS was an obvious factor for CS without those listed indications in the guideline. Lower maternal self-efficacy for childbirth might be a key determinant for CS on maternal request. More women with a Shanghai resident certificate (Hukou) ended up as pregnancy with CS than did women who were migrants living in Shanghai. Maternal age was found to only be associated with CS with guideline-defined indications.

One main finding from our study is that the CS with doctor-defined indications accounted for 34.9% of the

**Table 2** Comparison of actual MOD with antenatal maternal preference MOD (N=523)

	MOD preference in 2nd trimester*			p Value	MOD preference in 3rd trimester†			p Value
	VD (N (%))	CS (N (%))	No Preference (N (%))		VD (N (%))	CS (N (%))	No preference (N (%))	
Actual MOD				0.007‡				<0.001‡
VD	161 (42.9)	19 (27.1)	39 (50.0)		201 (48.1)	15 (16.5)	3 (21.4)	
Total CS	214 (57.1)	51 (72.9)	39 (50.0)		217 (51.9)	76 (83.5)	11 (78.6)	
CS on maternal request	25 (6.7)	13 (18.6)	8 (10.3)		20 (4.8)	26 (28.6)	0	
CS with doctor-defined indications	81 (21.6)	13 (18.6)	12 (15.4)		76 (18.2)	25 (27.5)	5 (35.7)	
CS with guideline-defined indications	108 (28.8)	25 (35.7)	19 (24.4)		121 (28.9)	25 (27.5)	6 (42.9)	

\*Average gestational weeks: 18.5, range: 13.1–27.7.

†Average gestational weeks: 37.1, range: 32.7–41.0.

‡p Values of Pearson  $\chi^2$  test in MOD preferences among women of VD, caesarean on maternal request, CS with doctor-defined indications and CS with guideline-defined indications.

CS, caesarean section; MOD, mode of delivery; VD, vaginal delivery.

**Table 3** Changes of maternal self-efficacy between the second and the third trimester by different MOD

	Score of SE in 2nd trimester*	p Value	Score of SE in 3rd trimester†	p Value
	Median (P <sub>25</sub> –P <sub>75</sub> )		Median (P <sub>25</sub> –P <sub>75</sub> )	
Actual MOD		<0.001‡		<0.001‡
VD	16.0 (13.0–19.0)		15.0 (14.0–19.0)	0.350§
CS on maternal request	13.0 (10.5–15.0)		12.0 (10.0–15.0)	0.575§
CS with doctor-defined indications	16.0 (13.0–19.0)		15.0 (11.0–17.0)	0.009§
CS with guideline-defined indications	15.0 (13.0–18.0)		15.0 (13.0–17.0)	0.512§

\*Score of self-efficacy in average gestational weeks: 18.5, range: 13.1–27.7.

†Score of self-efficacy in average gestational weeks: 37.1, range: 32.7–41.0.

‡p Values of Kruskal-Wallis test in maternal self-efficacy among women of VD, caesarean on maternal request, CS with doctor-defined indications and CS with guideline-defined indications.

§p Values of Wilcoxon signed-rank test in the changes of maternal self-efficacy between the second and the third trimester by different MODs. CS, caesarean section; MOD, modes of delivery; VD, vaginal delivery.

total number of CS cases. This illustrates that about one-third of the CS cases did not have CS indicators defined by the guideline or were not based on maternal requests. These cases were due largely to the loosening of criteria by doctors. The results from the analysis of the person who most influenced MOD in the multinomial logistic model support this argument. This finding on CS influenced by doctors is consistent with findings of other recent studies published.<sup>20 21 27</sup> Gao *et al*<sup>20</sup> reported that the overdiagnosis of fetal and maternal risks was the key determinant of high rates of CS in

China, rather than maternal requests. Feng *et al*<sup>21</sup> concluded that structural factors relating to service supply had greater impacts on rising CS rates than other demographic characteristics, including the household's willingness and ability to pay. A retrospective study in Shanghai found that a suggestion from the doctor was a strong predictor for CS.<sup>27</sup> The rising rate of CS, after the introduction of market mechanisms in health system reform,<sup>28</sup> might be attributed to perverse financial incentives associated with fee-for-service payment, increasing reliance on user charges to recouple the

**Table 4** Multinomial logistic statistical analysis for actual CS

	CS on maternal request		CS with doctor-defined indications		CS with guideline-defined indications	
	Crude OR	Adjusted OR (95% CI)	Crude OR	Adjusted OR (95% CI)	Crude OR	Adjusted OR (95% CI)
Self-efficacy in 2nd trimester	0.845*	0.845 (0.771 to 0.926)	1.001	0.990 (0.923 to 1.062)	0.969	0.981 (0.921 to 1.044)
Who mostly influenced MOD† decision						
Woman herself (ref)	1	1	1	1	1	1
Doctor	0.503	0.483 (0.131 to 1.788)	2.525*	2.504 (1.307 to 4.796)	2.129*	2.239 (1.222 to 4.102)
Others‡	0.641	0.640 (0.236 to 1.734)	0.541	0.417 (0.177 to 0.921)	0.314*	0.382 (0.180 to 0.810)
Preference of MOD in 2nd trimester						
No preference	0.300*	0.510 (0.164 to 1.583)	0.450	0.457 (0.162 to 1.286)	0.370*	0.372 (0.154 to 0.900)
VD preference	0.227*	0.345 (0.140 to 0.850)	0.735	0.809 (0.357 to 1.830)	0.510	0.519 (0.256 to 1.052)
CS preference (ref)	1	1	1	1	1	1
Age	1.040	1.021 (0.914 to 1.140)	1.006	0.980 (0.904 to 1.063)	1.106*	1.087 (1.012 to 1.167)
Residence status						
Shanghai residents (with Shanghai Hukou)	2.682*	2.758 (1.245 to 6.109)	1.610*	1.749 (1.036 to 2.953)	1.256	1.100 (0.692 to 1.747)
Migrants (without Shanghai Hukou to ref)	1	1	1	1	1	1
Number of induced abortions						
0 (ref)	1	1	1	1	1	1
1	1.786	1.868 (0.815 to 4.285)	1.910*	1.992 (1.0 903 640)	1.424	1.382 (0.790 to 2.416)
2 or more	1.767	3.106 (0.908 to 10.623)	2.352*	3.138 (1.317 to 7.476)	1.435	1.481 (0.634 to 3.461)

\*p<0.05.

†MOD.

‡Others included husband, elder members in family, friends, etc.

CS, caesarean section; MOD, modes of delivery; VD, vaginal delivery.

operational costs of healthcare, and the linkage between revenue generation and the income of Chinese doctors. This hypothesis is in accordance with studies<sup>29–30</sup> in south Asian communities and Western Australia, which found that the increased CS rates may be driven in part by the private sector, due to strong financial incentives for surgical procedures in that sector.

Another possible factor driving the rise of CS rates in China could be doctors' avoidance of potential practice risks. Shanghai introduced and has implemented the Maternal Death Audit System (MDAS) for almost 20 years.<sup>31</sup> Any maternal death case reported is reviewed and assessed by the system, which has put much pressure on each hospital in Shanghai. If the maternal death is categorised as type 1 (ie, avoidable) or type 2 (ie, missed opportunities) by the MDAS, the related health staff, managers and leaders receive disincentives. Therefore, doctors try their best to prevent maternal deaths, which may lead to their overactions towards any potential risks related to childbirth. At present, the relationship between doctors and patients in China is very tense, resulting in doctors being extra prudent.<sup>32</sup> As a consequence, many unnecessary CS procedures might be a response to such pressures. The practice in other countries of taking concerted actions to lower CS rates<sup>33</sup> should be adopted by China. According to the new guideline from the International Federation of Gynecology and Obstetrics, mother-baby 'friendly' birthing facilities might also be helpful in further improving quality care during labour and in lowering unnecessary CS procedures.<sup>34</sup>

Our findings on maternal self-efficacy revealed that low maternal self-efficacy was a key determinant of maternal request for CS. Self-efficacy was defined by Bandura,<sup>35</sup> in 1977, as confidence that one can successfully execute a course of action to produce a desired outcome in a given situation. Women's self-efficacy in childbirth is a strong, well-studied influencing factor, particularly in developed countries, since the 1990s.<sup>36</sup> However, studies on CS carried out in mainland China have rarely examined the possible impact of self-efficacy on the MOD. We found that higher maternal childbirth self-efficacy in the second trimester could lower CS on maternal request. In other words, CS on maternal request might relate to the level of women's confidence. Increasing maternal self-efficacy on childbirth would reduce maternal requests for CS.

In our study, maternal age was found to be associated with CS with guideline-defined indications, which was not surprising. Our study did not find the relationship of education levels and insurance coverage to be associated with MOD, unlike what many previously published studies reported. One possible reason is that a majority of the participants in our study were relatively homogeneous, that is, having higher education training (eg, more than 68.0% had at least a college degree) and having a high percentage of insurance.

Our study has a few limitations. First, the study's pregnant women were selected from only two general

hospitals located in one district of Shanghai, and might not reflect the situation in the rest of the country, or even that in the greater metropolitan area of Shanghai. Second, many women, mainly from the group of rural-to-urban migrants, dropped out during the study, as they decided to return to their hometown for delivery. However, we think such a problem would not affect the results significantly, as we used the data of other migrant women to replace the missing data and found the adjusted CS preference rate in the third trimester as 15.3% and the adjusted CS rate post partum as 56.2%, which were slightly lower than the actual rates (17.0% and 58.1%). And the rate of CS among the study population was 58.1%—very similar to the total CS rate of the two hospitals, 55.3%, in the study year 2011.

## CONCLUSIONS

In short, our study shows that Chinese doctors play an important role in the decision of using CS, without justified indications as defined in the guideline. A decision on the use of CS was often made during the third trimester of the pregnancy or during the process of labour. Low maternal childbirth self-efficacy was also a significant risk factor associated with maternal request for CS among primiparous Chinese women. Concerted action targeting service providers as well as users needs to be taken in the near future, in order to effectively control the rapid rise of CS in China.

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