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# BMJ Open

## Attendance of prenatal education course reduces caesarean section rate on maternal request: A questionnaire study in a tertiary women hospital in Shanghai, China

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Manuscripts

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3 **1 Attendance of prenatal education course reduces caesarean section rate on maternal**  
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5 **2 request: A questionnaire study in a tertiary women hospital in Shanghai, China**  
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3 **20 Abstract**  
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5 **21 Objective:** Caesarean section rate has significantly increased worldwide with China having a  
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8 **22** higher rate, including caesarean section on maternal request. In this study, we investigated the  
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10 **23** association between maternal characteristics and caesarean section on maternal request.

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12 **24 Design:** Questionnaire study

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14 **25 Setting:** tertiary hospital in China

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16 **26 Sample:** 564 questionnaires

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19 **27 Methods:** On day 42 of post-partum, questionnaire data were collected. Data including age,  
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22 **28** parity, gravida, delivery mode, educational level, residence status, living condition and  
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24 **29** attendance of prenatal education course were analysed.

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26 **30 Primary and secondary outcome measures:** Factors associated with caesarean section on  
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28 **31** maternal request.

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31 **32 Results:** 46% of women were delivered by caesarean section on maternal request. Maternal  
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33 **33** age, residence status and attendance of prenatal education course were significantly  
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35 **34** associated with caesarean section on maternal request. The odds ratio of an increase in  
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37 **35** caesarean section on maternal request in women over 30 years was 2.42 (95%CL: 1.597,  
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39 **36** 3.666), compared to women under 30 years. 75% more women who reside in Shanghai had  
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41 **37** caesarean section on maternal request, compared to women who live outside of Shanghai.  
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43 **38** However, there was a significant reduction (35%) in the number of caesarean section on  
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45 **39** maternal request in women who attended a prenatal education course ( $p=0.029$ ). There was  
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47 **40** no factor associated with attendance of prenatal education course.

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51 **41 Conclusion:** Although maternal age increased the risk of caesarean section on maternal  
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53 **42** request, attendance of a prenatal education course significantly reduced this increased rate.  
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55 **43** Our data suggest that promotion of prenatal education course is very important in China to  
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57 **44** reduce the rate of caesarean section.  
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3 45 **Strengths and limitations of this study**  
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5 46 1. Prenatal education course has not been performed in most of women's hospital in  
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8 47 China.

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10 48 2. This survey study was done in the largest women's hospital in China with more than  
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12 49 12,000 deliveries a year.

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14 50 3. We found that attendance of a prenatal education course could affect the rate of  
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17 51 caesarean section on maternal request.

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19 52 4. Regional difference in China may also result in a bias.  
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3 55 **Key Words:** caesarean section rate; prenatal education course; maternal request  
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## 57 **Introduction**

58 The rate of caesarean section has significantly increased worldwide over the last decades (1).

59 Caesarean section can result in a small overall increase in poor outcomes in women with low

60 risk and typically takes longer to recover than vaginal birth. Caesarean section also increases

61 the risk of infection and associated morbidity up to 20 folds in comparison to vaginal delivery

62 (1). Therefore, World Health Organization (WHO) recommends that caesarean section should

63 be performed only when there is a medical indication (WHO Statement on Caesarean Section

64 Rate, 2015). Today globally, approximate 2.5% to 18% caesarean sections are carried out

65 without any medical indication, dependent on the regions (1-3).

66 According to WHO report, China has a higher caesarean section rate in comparison to other

67 countries. Previous studies reported that the caesarean section rate has significantly increased

68 to 35% - 50% (regionally dependent) in China (4, 5) and the most recent caesarean section

69 rate was approximately 46% in China (1). The predominant reason for this trend may be

70 because the number of caesarean section on maternal request is increased since last decade in

71 China (4, 5). Worldwide estimated caesarean section rate on maternal request was 10-20%

72 among Northern Europe, the United States, Sweden and Australia (6-9). We previously

73 reported in 2012 that the caesarean section rate on maternal request was about 10% in China

74 (10), however a recent study reported the caesarean section rate on maternal request has

75 significantly increased to 38% in China (11).

76 Fear and anxiety of childbirth as well as psychological stress during labour and birth appear

77 to be the most important reasons for caesarean section on maternal request. About 5–40% of

78 pregnant women fear childbirth in western countries (12, 13), and a recent study reported that

79 Chinese pregnant women have moderate levels of childbirth fear and anxiety (14). In addition,

80 failure of hospitals to support normal delivery including a birthing environment can result in

81 maternal stress and anxiety during labour and birth (15). A satisfying birth environment can

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3 82 minimize maternal stress and anxiety during labour and birth and support physiologic birth  
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5 83 (15). Furthermore, safety of the baby has become another main reason for caesarean section  
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7 84 on maternal request in a large proportion of pregnant women (16). However, factors  
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9 85 associated with caesarean section on maternal request may vary by the ethnicities. This is  
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11 86 because the educational levels of pregnant women, prenatal care system, economic condition  
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13 87 and performance of prenatal education course are different among countries and ethnicities.  
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15 88 In addition, the ethical principles of medical practice are influenced by the patient-doctor  
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17 89 relationship. To date, study about the association of maternal characterises or social  
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19 90 environment and caesarean section on maternal request is limited. In this retrospective study  
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21 91 we analysed the factors that are associated with caesarean section on maternal request in one  
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23 92 of the largest tertiary hospital in Shanghai, China.  
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## 97 **Methods**

98 This questionnaire study was performed in The Hospital of Obstetrics & Gynaecology of  
99 Fudan University, Shanghai, China from January 2017 to June 2017. This study was  
100 approved by the ethics board of The Hospital of Obstetrics & Gynaecology of Fudan  
101 University (Reference No. 2017-04).

## 103 **Patient and Public Involvement**

104 There was no patient and public involvement in this study.

## 106 **Study design and participants**

107 A total of 600 pregnant women with a live fetus at term at our hospital who came back for  
108 post-partum clinic at day 42 at our hospital were asked to complete a questionnaire. All these  
109 pregnant women had no maternal and fetal complications during pregnancy. All these women  
110 voluntarily completed the questionnaire. The questionnaire included basic maternal  
111 characteristics and postpartum care including breastfeeding as well as neonatal care  
112 information. Of them, 580 questionnaires were returned and after excluding 16 invalid  
113 questionnaires, 564 questionnaires were analysed in this study (Figure 1). In this study we  
114 analysed the first part of questionnaire: factors associated with caesarean section on maternal  
115 request. Basic maternal characteristics included maternal age, parity, gravida, delivery mode,  
116 maternal weight before pregnancy, educational level of mother, residence status (permanently  
117 reside in Shanghai or permanently live outside of Shanghai), living condition and attendance  
118 of prenatal education course. Living condition was referred as economic level.  
119 The prenatal education course is designed as a free half-day intensive one by one course for  
120 pregnant women between 36 and 37 weeks of gestation in our hospital. The course is led and  
121 run by experienced or specialised midwives in our hospital. Course information focuses on

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3 122 supporting pregnant women to prepare for labour and normal births including the role of the  
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5 123 father during labour and birth, labour coping skills and management of pain in order to avoid  
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8 124 medical intervention during labour and birth.

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10 125 The Hospital of Obstetrics & Gynaecology of Fudan University is one of the largest tertiary  
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12 126 maternity hospitals with advanced prenatal care system and is located in Shanghai, a wealthy  
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14 127 city in China. This consequently results in many women who live outside of Shanghai to  
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16 128 come to give birth in our hospital. Our hospital has more than 12,000 deliveries a year.

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### 20 21 130 **Power of sample size**

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24 131 A sample size calculation was based on the estimated incidence of caesarean section (40%) in  
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26 132 China (1) and at least 130 respondents were needed for a statistical power of 90% for each  
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28 133 group to detect a significant difference between two groups at a level of 0.05 (two-tailed). We  
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30 134 overenrolled to allow for attrition, section our final recruitment target at 600 women.

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### 34 35 136 **Statistical Analysis**

36  
37 137 The statistical difference in maternal age and maternal body weight before pregnancy  
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39 138 between women with vaginal delivery and women with caesarean section was assessed with a  
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41 139 Mann-Whitney U-test using the Prism software package. The statistical difference in parity,  
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43 140 gravida, educational level, residence status, attendance of a prenatal education course  
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45 141 between women with vaginal delivery and women with caesarean section was assessed with  
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47 142 Chi-square test (or Fisher's exact test) using the Prism software package. The analysis in the  
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49 143 rate of caesarean section on maternal request was assessed by odds ratio was analysed and  
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51 144 95% confidence limits (CL) using OpenEpi software. P-values of <0.05 were considered  
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53 145 significant.

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**Results:**

The median maternal age was 32 years (ranging from 23 to 48 years). Of 564 women, 469 (83%) women were nulliparous and 304 (54%) women had a vaginal delivery and 260 (46%) women had a caesarean section on maternal request. The majority of women (97%) received a tertiary or above education and 448 (80%) women lived in Shanghai. Only 116 (20.6%) women attended the prenatal education course before delivery.

The demographic information of women with vaginal delivery and with caesarean section are summarised in Table 1. There was no statistical difference in parity, gravida, educational level and maternal weight before pregnancy between women with vaginal delivery and women with caesarean section (Table 1). However, the maternal age in women with caesarean section was statistically more significant than women with vaginal delivery ( $p=0.008$ , Table 1). In addition, women who reside in Shanghai had a significantly higher caesarean section rate, in comparison to women who live outside of Shanghai ( $p=0.005$ , Table 1). The odds ratio of an increase in caesarean section on maternal request in women who reside in Shanghai was 1.749 (95%CL: 1.14, 2.67, Table 3), compared to women who live outside of Shanghai. In addition, women who attended the prenatal education course had a significantly lower rate of caesarean section on maternal request, compared to women who did not attend to prenatal education course ( $p=0.045$ , Table 1). The odds ratio of a reduction in caesarean section on maternal request in women who attended to prenatal education course was 0.656 (95%CL: 0.432, 0.997, Table 3), compared to women who did not attend to prenatal education course.

To analyse the association of caesarean section on maternal request and age distribution, we then divided the maternal age into three groups (Table 2). We found that women between 30 to 39 years had the highest caesarean section rate (78%), compared to women between 20 to 29 years (15%) or women over 40 years (6.5%).

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3 172 We then analysed whether there is a difference in educational levels between women who  
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5 173 reside in Shanghai and women who live outside of Shanghai. There was no statistical  
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7 174 difference in tertiary or above level education between two groups (98% vs 93%).  
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9 175 We further analysed factors which affected pregnant women attending the prenatal education  
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11 176 course (Table 4). There was no statistical difference in maternal age, educational level,  
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13 177 residence status, parity and gravida between women who attended to prenatal education  
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15 178 course and women who did not.  
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## 180 **Discussion**

### 181 **Main Findings**

182 In this questionnaire study with a medium sample size, we found that maternal age, residence  
183 status and attendance of a prenatal education course could affect the rate of caesarean section  
184 on maternal request. In contrast, parity, gravida and maternal education level were not  
185 associated with rate of caesarean section on maternal request. In addition, there were no  
186 factors associated with attendance of the prenatal education course.

### 187 **Strengths and Limitations**

188 China has a highest caesarean section rate worldwide and approximate 40% of these cases did  
189 not have any medical indications for caesarean section. To reduce the caesarean section rate  
190 is a challenge to midwives and obstetricians. Prenatal education course have been shown  
191 many benefits to pregnant women in order to reduce fear and anxiety of childbirth as well as  
192 psychological stress during labour and birth. But whether it can reduce the rate of caesarean  
193 section on maternal request has not been fully investigated. In addition, prenatal education  
194 course has not been fully set up in most maternity hospitals in China. The Hospital of  
195 Obstetrics & Gynaecology of Fudan University is one of the largest tertiary and leading  
196 maternity hospitals with advanced prenatal care system in China.

197 There were some limitations in this study. First, this questionnaire study was done in a single  
198 tertiary women hospital in Shanghai. Second, our prenatal education course was not designed  
199 to reduce rates of obstetric intervention. This limitation must be taken into account about the  
200 association between prenatal education course and perinatal outcomes. In addition, regional  
201 difference in China may also result in a bias.

### 202 **Interpretation**

203 It has been reported that the caesarean section has doubled from 2003 to 2018 to reach 21%,  
204 and is increasing annually by 4% worldwide. The predominant reasons for this increased

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3 205 trend are unclear, but the increased caesarean section on maternal request could be one of the  
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5 206 main reasons. China has highest caesarean section rate and the rate of caesarean section on  
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7 207 maternal request has also significantly increased to 38% in China in 2017 (11). In our current  
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9 208 study, the rate of caesarean section on maternal request was 46%. Due to limited resources of  
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11 209 health care facilities, the birthing environment in China such as individual delivery room and  
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13 210 family member support during labour and birth are not routine practice in China. These  
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15 211 conditions could result in a fear of childbirth and increased psychological stress to pregnant  
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17 212 women. In addition, the long term One Child Policy (around 40 years) which ended in  
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19 213 October 2015 may contribute to this increase. This policy may change the philosophy of  
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21 214 childbirth to pregnant women. As women can only give birth once, pregnant women  
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23 215 including their family members did not consider the risks of a caesarean section on future  
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25 216 pregnancies instead of only considering the safety of the baby (16).

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27 217 It has been reported that caesarean section rate is associated with maternal age and women  
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29 218 with advanced maternal age have the highest caesarean section rate (17). This could be  
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31 219 because advanced maternal age is associated with a number of complications of pregnancy  
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33 220 such as preeclampsia and gestational diabetes mellitus (GDM) (18). However, advanced  
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35 221 maternal age is also associated with an increased risk of obstetric intervention including  
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37 222 caesarean section (19-21) and obstetrics blood loss during labour and birth in low-risk  
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39 223 pregnant women (22). These adverse outcomes during labour and birth could result in a fear  
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41 224 to pregnant women with advanced maternal age. In our current study, we found that the rate  
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43 225 of caesarean section on maternal request was significantly increased with maternal age and  
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45 226 85% pregnant women with age over 30 years had caesarean section on maternal request in all  
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47 227 cases with caesarean section on maternal request. The odds ratio of an increase in caesarean  
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49 228 section on maternal request in pregnant women over 30 years was 2.42 (95%CL: 1.597,  
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3 229 3.666), compared to pregnant women under 30 years. In addition, pregnant women between  
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5 230 30-39 years had the highest rate of caesarean section on maternal request.  
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7 231 Prenatal education course is well performed in western countries for a long time but not in  
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9 232 most maternity hospitals in China. The main purpose of a prenatal education course is to  
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11 233 support pregnant women to prepare for labour and birth including pain management as well  
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13 234 as care of newborn (23). The prevalence of attendance of prenatal education course was 33%  
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15 235 in Canada (24) and 84% in nulliparous women in Australia (25). Because the prenatal  
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17 236 education course is a new program in China and in our hospital (under 5 years), the  
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19 237 prevalence of attendance of prenatal education course was only 20% in this study, which was  
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21 238 significantly lower than western countries. However, in our current study we showed a  
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23 239 significant reduction (35%) in the number of caesarean section on maternal request in  
24  
25 240 pregnant women (n=116) who attended the prenatal education course. Other study reported  
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27 241 that the prenatal education course increased the vaginal delivery rate (24). We further  
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29 242 analysed the factors that are associated with attendance of a prenatal education course and  
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31 243 found that maternal age, educational level, parity, gravida and residence status did not  
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33 244 influence pregnant women attending a prenatal education course. Other studies have showed  
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35 245 nulliparous or older pregnant women had higher attendance than multiparous or younger one  
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37 246 (25). This higher attendance was also observed in pregnant women with higher income and  
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39 247 higher education level (23, 25). The difference in these factors between our current study and  
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41 248 other studies could be explained by the short duration of the prenatal education course in our  
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43 249 hospital and it has not been strongly recommended yet, by midwife or obstetrician.  
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45 250 Interestingly in this study we found that women who reside in Shanghai had a higher rate of  
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47 251 caesarean section on maternal request, compared to women who did not reside in Shanghai.  
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49 252 We do not know the exact reason for this difference. We analysed the educational level  
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51 253 between these two groups of women and found there was no difference in the educational  
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3 254 level between two groups. However, we found the maternal age in women who reside in  
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5 255 Shanghai was significantly older than women who did not reside in Shanghai by 1.2 years  
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8 256 ( $p=0.006$ ). As we discussed before, advanced maternal age is associated with an increased  
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10 257 risk of obstetric intervention. This may be one of the causes for women who reside in  
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12 258 Shanghai considering caesarean section. Another possible reason for this difference may be  
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14 259 because Shanghai is a wealthy city in China and culturally women who reside in Shanghai  
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16  
17 260 traditionally trended to be more apprehensive, regarding most aspects of life, compared to  
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19 261 women who live outside of Shanghai.

## 21 262 **Conclusion**

23  
24 263 In this study, in low risk pregnant women we found that maternal age, residence status and  
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26 264 attendance of prenatal education course were associated with caesarean section on maternal  
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28 265 request. Attendance of a prenatal education course can significantly reduce caesarean section  
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30 266 on maternal request. Our findings suggest that promotion of the prenatal education course is  
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33 267 very important in China to reduce the caesarean section rate.  
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11

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15  
16 275 **Declaration of Interest**  
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18 276 All authors have no conflict of interest to report.  
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22  
23 278 **Contribution to authorship:**  
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25  
26 279 All authors were involved in the drafting, editing and approval of the manuscript for  
27  
28 280 publication. In addition to this, each author contributed to follow work:

29  
30 281 YG, YT: collected the data reported in this work  
31

32 282 MT, YD: contributed to conception and design of this study  
33

34 283 YD, QC: designed study and wrote the manuscript draft  
35  
36 284

37  
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39 285 **Ethics approval**  
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41 286 This study was approved by the ethics board of The Hospital of Obstetrics & Gynaecology of  
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3 353 **Figure legend**  
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5 354 Figure 1: Flow chart of data collection  
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355 **Table 1: General clinical parameters in study cohort according to the mode of delivery**

	<b>Vaginal delivery (n=304)</b>	<b>caesarean section (n=260)</b>	<b>P-value</b>
<b>Maternal age (years, median/range)</b>	32 (24-48)	33 (23-45)	<b>P=0.008</b>
<b>Parity (number, %)</b>			
1 (n=469)	258 (55%)	211 (45%)	0.24
2 (n=95)	46 (48%)	49 (52%)	
<b>Gravida (number, %)</b>			
1 (n=415)	232 (56%)	183 (44%)	0.281
2 (n=122)	59 (48%)	63 (52%)	
≥3 (n=27)	13 (48%)	14 (52%)	
<b>Education Level (number, row%)</b>			
Under tertiary (n=18)	8 (44%)	10 (56%)	0.728
Under graduate (n=450)	244 (54%)	206 (46%)	
Post graduate (n=96)	52 (54%)	44 (46%)	
<b>Residence (number, row%)</b>			
Shanghai (n=448)	229 (51%)	219 (49%)	<b>P=0.009</b>
Non-Shanghai (n=116)	75 (64%)	41 (36%)	
maternal weight before pregnancy (kg, mean/SD)	55.28±7.76	55.36±8.98	P=0.902
<b>Living conditions</b>			
Own house (n=489)	255 (52%)	234 (48%)	0.0802
Rental house (n=25)	15 (60%)	10 (40%)	
Parent's house (n=45)	31 (68%)	14 (32%)	
<b>Attendance of a prenatal education course (number, row%)</b>			
Yes (n=116)	72 (62%)	44 (38%)	<b>P=0.045</b>
No (n=448)	232 (52%)	216 (48%)	

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358 **Table 2: The association of age distribution and rate of caesarean section on maternal**  
 359 **request**

Age distribution	Women with caesarean section (n=260)	P value
20-29 years (number, %) (Lower CL, Upper CL)	39 (15%) (10.89%, 19.93%)	p<0.001
30-39 years (number, %) (Lower CL, Upper CL)	204 (78.5%) (72.96%, 83.3%)	
≥40 years (number, %) (Lower CL, Upper CL)	17 (6.5%) (3.85%, 10.26%)	

360 CL: confidence Limits

362 **Table 3: Odds ratio (OR) and 95% confidence limits (CL) for the effect of maternal age,**  
 363 **residence and attendance of a prenatal education course on caesarean section rate**

	Caesarean section	Vaginal delivery	OR	95%CL	P value
<b>Maternal age (number, %)</b>					
20-29 years (n=130)	39 (30%)	91 (70%)	2.392	1.57, 3.65	<0.0001
30-39 years (n=403)	204 (51%)	199 (49%)			
<b>Maternal age (number, %)</b>					
30-39 years (n=403)	204 (51%)	199 (49%)	0.844	0.41, 1.75	0.395
≥40 years (n=31)	17 (55%)	14 (45%)			
<b>Maternal age (number, %)</b>					
20-29 years (n=130)	39 (30%)	91 (70%)	2.833	1.27, 6.31	0.009
≥40 years (n=31)	17 (55%)	14 (45%)			
<b>Residence status (number, %)</b>					
Shanghai (n=448)	219 (84%)	229 (75%)	1.749	1.14, 2.67	0.005
Non-Shanghai (n=116)	41 (16%)	75 (25%)			
<b>Attendance of a prenatal education course (number, %)</b>					
Yes (n=116)	44 (38%)	72 (62%)	0.656	0.43, 0.99	0.029
No (n=448)	216 (48%)	232 (52%)			

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366 **Table 4: Factors associated with attendance of a prenatal education course**

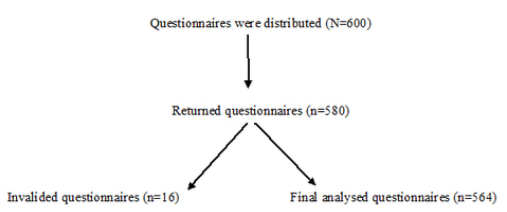
	Attendance of prenatal education course		P value (Chi-square)
	Yes (n=116)	No (n=448)	
<b>Maternal age distribution</b>			
20-29 years (n=130)	24 (18.5%)	106 (81.5%)	0.708
30-39 years (n=403)	85 (21.2%)	318 (78.9%)	
≥40 years (n=31)	7 (22.6%)	24 (77.4%)	
<b>Residence (number, %)</b>			
Shanghai (n=448)	91 (20%)	357 (80%)	0.796
Non-Shanghai (n=116)	25 (22%)	91 (78%)	
<b>Education level (number, %)</b>			
Under tertiary (n=18)	2 (11%)	16 (89%)	0.328
Under graduate (n=450)	90 (20%)	360 (80%)	
Post graduate (n=96)	24 (25%)	72 (75%)	
<b>Parity (number, %)</b>			
1 (n=469)	103 (22%)	366 (78%)	0.071
2 (n=95)	13 (14%)	82 (86%)	
<b>Gravida (number, %)</b>			
1 (n=415)	91 (22%)	324 (78%)	0.297
2 (n=122)	22 (18%)	100 (82%)	
≥3 (n=27)	3 (11%)	24 (89%)	

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Figure 1



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# BMJ Open

## Does attendance of a prenatal education course reduce rates of caesarean section on maternal request? A questionnaire study in a tertiary women hospital in Shanghai, China

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<b>Primary Subject Heading</b>:	Medical education and training
Secondary Subject Heading:	Obstetrics and gynaecology
Keywords:	caesarean section, prenatal education course, maternal request

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Manuscripts

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3 **1 Does attendance of a prenatal education course reduce rates of caesarean section on**  
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5 **2 maternal request? A questionnaire study in a tertiary women hospital in Shanghai,**  
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7 **3 China**  
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23 10 Running title: Factors associated with caesarean section  
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42 19 Phone: 86-13611691734

## 21 Abstract

22 **Objective:** Caesarean section rates have significantly increased worldwide. China has a  
23 caesarean rate of 46%, with a moderate contribution of caesarean section on maternal request.  
24 In this study, we investigated the association between maternal characteristics, attendance at a  
25 prenatal education course and caesarean section on maternal request.

26 **Design:** Questionnaire study

27 **Setting:** Tertiary hospital in China

28 **Sample:** 564 questionnaires

29 **Methods:** On post-partum day 42, questionnaire data were collected. Data including age,  
30 parity, gravida, delivery mode, educational level, residence status, living condition and  
31 attendance of prenatal education course were analysed.

32 **Primary and secondary outcome measures:** Factors associated with caesarean section on  
33 maternal request.

34 **Results:** 46% of women were delivered by caesarean section on maternal request. Maternal  
35 age and residence status were all significantly associated with having a caesarean section on  
36 maternal request. The odds ratio of an increase in caesarean section on maternal request in  
37 women over 30 years was 2.42 (95%CL: 1.597, 3.666), compared to women under 30 years.  
38 75% more women who resided in Shanghai had caesarean section on maternal request,  
39 compared to women who resided outside of Shanghai. However, there was a significant  
40 reduction (35%) in the number of caesarean sections on maternal request in women who  
41 attended a prenatal education course ( $p=0.029$ ). There was no significant association between  
42 attendance of a prenatal education course and the other maternal characteristics studied.

43 **Conclusion:** Maternal age is associated with an increased risk of caesarean section on  
44 maternal request. For women of all age, attendance of a prenatal education course  
45 significantly reduced the rate of caesarean section on maternal request. Our data suggest that

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46 promotion of a prenatal education course is an important tool in China to reduce the rate of  
47 caesarean section.

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3 49 **Strengths and limitations of this study**  
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- 5 50 1. Prenatal education courses are not performed in most women's hospital in China.  
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8 51 2. This survey study was done in the largest women's hospital in China with more than  
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10 52 12,000 deliveries a year.  
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12 53 3. We found that attendance of a prenatal education course could affect the rate of  
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14 54 caesarean section on maternal request.  
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17 55 4. Regional difference in China may also result in a bias.  
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58 **Key Words:** caesarean section rate; prenatal education course; maternal request

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## 60 **Introduction**

61 The rate of caesarean section has significantly increased worldwide over the last three  
62 decades (1). Caesarean section in low risk women can result in a small overall increase in  
63 poor outcomes and typically takes longer to recover from than vaginal birth. Caesarean  
64 section also increases the risk of infection and associated morbidity up to 20 folds in  
65 comparison to vaginal delivery (1). Therefore, the World Health Organization (WHO)  
66 recommends that caesarean section should be performed only when there is a medical  
67 indication (WHO Statement on Caesarean Section Rate, 2015). Today globally, approximate  
68 2.5% to 18% of caesarean sections are carried out without any medical indication, dependent  
69 on the regions (1-3).

70 According to the WHO report, China has a higher caesarean section rate in comparison to  
71 other countries. Previous studies reported that the caesarean section rate has significantly  
72 increased to 35% - 50% (regionally dependent) in China (4, 5) and the most recent caesarean  
73 section rate was approximately 46% in China (1). The predominant reason for this trend may  
74 be an increase in the number of caesarean section on maternal request in the last decade (4, 5).  
75 Worldwide, the estimated rate of caesarean section on maternal request was 10-20% in  
76 Northern Europe, the United States, Sweden and Australia (6-9). We previously reported in  
77 2012 that the rate of caesarean section on maternal request was about 10% (10). However a  
78 recent study reported the rate of caesarean section on maternal request has significantly  
79 increased to 38% in China (11).

80 Fear and anxiety of childbirth as well as psychological stress during labour and birth appear  
81 to be the most important reasons for caesarean section on maternal request. About 5–40% of  
82 pregnant women fear childbirth in western countries (12, 13), and a recent study reported that  
83 Chinese pregnant women have moderate levels of childbirth fear and anxiety (14). In addition,  
84 failure of hospitals to support normal delivery including a supportive birthing environment



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3 85 can result in maternal stress and anxiety during labour and birth (15). A satisfying birth  
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5 86 environment can minimize maternal stress and anxiety during labour and birth and support  
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7 87 physiologic birth (15). Finally, concerns about the safety of the baby have become another  
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9 88 main reason for caesarean section on maternal request in a large proportion of pregnant  
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11 89 women (16).

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14 90 Globally, factors associated with caesarean section on maternal request may vary.

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17 91 Educational levels of pregnant women, prenatal care system, economic condition, the patient-  
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19 92 doctor relationship and performance of prenatal education course are different among  
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21 93 countries and ethnicities. To date, studies investigating the association of maternal  
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23 94 characteristics or social environment and caesarean section on maternal request are limited.

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26 95 In this retrospective study, we analysed the factors that are associated with caesarean section  
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28 96 on maternal request in one of the largest tertiary women hospitals in China.

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## 101 **Methods**

102 This questionnaire study was performed in The Hospital of Obstetrics & Gynaecology of  
103 Fudan University, Shanghai, China from January 2017 to June 2017. This study was  
104 approved by the ethics board of The Hospital of Obstetrics & Gynaecology of Fudan  
105 University (Reference No. 2017-04).

## 107 **Patient and Public Involvement**

108 There was no patient and public involvement in this study.

## 110 **Study design and participants**

111 A total of 600 pregnant women who delivered a live fetus at term in our hospital and returned  
112 for post-partum clinic on day 42 were asked at random to complete a voluntary questionnaire.  
113 All women surveyed had no maternal and fetal complications during pregnancy and delivery.  
114 The questionnaire included questions on basic maternal characteristics, postpartum care  
115 including diet, breastfeeding and neonatal care. To reduce the recall bias, this study was  
116 carried out in six months. 580 questionnaires were returned, 16 invalid questionnaires were  
117 excluded as they were incompleteness and overall 564 questionnaires were analysed in this  
118 study (Figure 1). In this study, factors associated with caesarean section on maternal request  
119 were analysed. Basic maternal characteristics included maternal age, parity, gravida, delivery  
120 mode, maternal weight before pregnancy, educational level of mother, residence status  
121 (permanently reside in Shanghai or permanently reside outside of Shanghai), living  
122 conditions and attendance of a prenatal education course. Living condition was referred as  
123 economic level. Caesarean section on maternal request was defined as a planned elective  
124 caesarean section with no medical indication. No women who had an emergency Caesarean  
125 section were included in our study.

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3 126 The prenatal education course described in our study is a free half-day intensive one by one  
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5 127 course for pregnant women between 36 and 37 weeks of gestation in our hospital. It is  
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8 128 common that either husbands or parents (in particular pregnant women's mothers) come  
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10 129 along with the pregnant women. The course is led and run by experienced and specialised  
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12 130 midwives in our hospital. Course information focuses on supporting pregnant women to  
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15 131 prepare for labour and normal births including the role of the father during labour and birth,  
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17 132 labour coping skills and management of pain during labour and birth.

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19 133 The Hospital of Obstetrics & Gynaecology of Fudan University is located in Shanghai, the  
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21 134 wealthiest city in China, and is a leading provider of tertiary maternity care. Many women  
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24 135 who reside outside of Shanghai come to give birth in our hospital because of the services  
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26 136 provided and the hospital has more than 12,000 deliveries in a year.

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### 30 138 **Power of sample size**

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33 139 The sample size calculation was based on the estimated incidence of caesarean section (40%)  
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35 140 in China (1). At least 130 respondents were needed for a statistical power of 90% for each  
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37 141 group to detect a significant difference between two groups at a level of 0.05 (two-tailed). We  
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39 142 overenrolled to allow for attrition, setting our final recruitment target at 600 women.

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### 43 144 **Statistical Analysis**

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47 145 The statistical difference in maternal age and maternal body weight before pregnancy  
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49 146 between women with vaginal delivery and women with caesarean section was assessed with a  
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51 147 Mann-Whitney U-test using the Prism software package. The statistical difference in parity,  
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53 148 gravida, educational level, residence status, attendance of a prenatal education course  
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56 149 between women with vaginal delivery and women with caesarean section was assessed with  
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58 150 Chi-square test (or Fisher's exact test) using the Prism software package. The analysis in the

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3 151 rate of caesarean section on maternal request was assessed by odds ratio and 95% confidence  
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5 152 limits (CL) using OpenEpi software. P-values of <0.05 were considered significant.  
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**Results:**

The median maternal age was 32 years (ranging from 23 to 48 years). Of 564 women, 469 (83%) women were nulliparous and 304 (54%) women had a vaginal delivery and 260 (46%) women had a planned caesarean section on maternal request. The majority of women (97%) had a tertiary or above education (a bachelor's degree or Masters or PhD) and 448 (80%) women resided in Shanghai. Only 116 (20.6%) women attended the prenatal education course before delivery.

The demographic information of women with vaginal delivery and with caesarean section are summarised in Table 1. There was no statistical difference in parity, gravida, educational level and maternal weight before pregnancy between women with vaginal delivery and women with caesarean section (Table 1). However, the maternal age in women with caesarean section was significantly higher compared to women with vaginal delivery ( $p=0.008$ , Table 1). In addition, women who resided in Shanghai had a significantly higher caesarean section rate than women who resided outside of Shanghai ( $p=0.005$ , Table 1). The odds ratio of an increase in caesarean section on maternal request in women who resided in Shanghai was 1.749 (95%CL: 1.14, 2.67, Table 2), compared to women who resided outside of Shanghai. Women who attended the prenatal education course had a significantly lower rate of caesarean section on maternal request compared to women who did not attend to the prenatal education course ( $p=0.045$ , Table 1). The odds ratio of a reduction in caesarean section on maternal request in women who attended to the prenatal education course was 0.656 (95%CL: 0.432, 0.997, Table 2), compared to women who did not attend to the prenatal education course.

To analyse the association of caesarean section on maternal request and age distribution, we then divided women into three groups by age (Table 3). We found that women between 30 to

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3 179 39 years had the highest caesarean section rate (78%) compared to women between 20 to 29  
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5 180 years (15%) or women over 40 years (6.5%).  
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8 181 We then analysed whether there was a difference in educational levels between women who  
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10 182 resided in Shanghai and women who resided outside of Shanghai. There was no statistical  
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12 183 difference in tertiary or above level education between the two groups (98% vs 93%).  
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14 184 We further analysed factors which affected pregnant women attending of a prenatal education  
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16 185 course (Table 4). There was no statistical difference in maternal age, educational level,  
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18 186 residence status, parity and gravida between women who attended to the prenatal education  
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20 187 course and women who did not.  
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## 189 **Discussion**

### 190 **Main Findings**

191 In this questionnaire study with a medium sample size, we found that maternal age, residence  
192 status, and attendance of a prenatal education course could affect the rate of caesarean section  
193 on maternal request. In contrast, parity, gravida and maternal education level were not  
194 associated with an increased rate of caesarean section on maternal request. In addition, there  
195 were significant association between attendance of a prenatal education course and the other  
196 maternal characteristics studied.

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### 198 **Strengths and Limitations**

199 The effect of attendance of a prenatal education course on the rate of caesarean section on  
200 maternal request has not been fully investigated. In addition, prenatal education courses have  
201 not been fully set up in most maternity hospitals in China. The Hospital of Obstetrics &  
202 Gynaecology of Fudan University is one of the largest and top ranked tertiary maternity  
203 hospitals with more than 12,000 deliveries a year in China. Our hospital does provide a one  
204 on one prenatal education course.

205 There were some limitations in this study. First, our questionnaire study was done in a single  
206 tertiary women hospital with a relative medium sample size (n=564), but this was relatively  
207 small compared to the 12,000 deliveries in the hospital every year. Our hospital's maternity  
208 care package may be different to other hospitals in China and these regional differences may  
209 result in a bias. Therefore our findings need to be further investigated with a large multicenter  
210 trial. Second, our prenatal education course was not designed to reduce the rates of obstetric  
211 intervention. This limitation must be taken into account when considering the association  
212 between prenatal education courses and perinatal outcomes. Third, due to the nature of the

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3 213 questionnaire study, all the data used in our study were self-reported. A possible recall bias  
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5 214 should also be taken into account.  
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10 216 **Interpretation**

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12 217 Compared to 2003, worldwide caesarean section rates have doubled by 2018. There are  
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14 218 varied reasons for this increasing trend, but we believe that the increased rate of caesarean  
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16 219 section on maternal request is an important factor, particular in the high rates of caesarean  
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18 220 section, including the rate of caesarean section on maternal request in China (11). In our  
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20 221 current study of uncomplicated pregnancies and deliveries, the rate of planned caesarean  
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22 222 section on maternal request was 46%. Previous study suggested that a supportive birth  
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24 223 environment can minimize maternal stress and anxiety during labour and birth and support  
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26 224 physiologic birth (15). Unfortunately, due to limited resources of many health care facilities,  
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28 225 the birthing environment in China may not always be conducive to supporting natural births.  
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30 226 Individual delivery room and family member support in labour are not routine practice in  
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32 227 most maternity hospitals in China. Conditions like these could result in a fear of childbirth  
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34 228 and increased psychological stress to pregnant women. In addition, the long term One Child  
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36 229 Policy, which extended from 1979 to 2015, may contribute to changing women and their  
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38 230 families' philosophy around childbirth. If a woman can only have one child, she may not  
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40 231 consider the risks of a caesarean section on future pregnancies to be relevant (16).  
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42 232 Increasing maternal age is associated with an increased caesarean section rates and women  
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44 233 with advanced maternal age have the highest caesarean section rate (17). Advanced maternal  
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46 234 age is associated with a number of complications of pregnancy such as preeclampsia and  
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48 235 gestational diabetes mellitus (GDM) (18), obstetric assisted delivery (including emergency  
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50 236 caesarean section) (19-21), and obstetrics blood loss during labour and birth (22). These  
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52 237 adverse outcomes during labour and birth could result in a fear to pregnant women with  
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3 238 advanced maternal age. In our current study, we found that the rate of caesarean section on  
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5 239 maternal request was significantly associated with maternal age. We found that in women  
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8 240 who requested the planned caesarean section, 85% of them were over 30 years. The odds  
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10 241 ratio of an increase in caesarean section on maternal request in pregnant women over 30  
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12 242 years was 2.42 (95%CL: 1.597, 3.666), compared to pregnant women under 30 years. We  
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14 243 also found that pregnant women between 30-39 years had the highest rate of caesarean  
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17 244 section on maternal request.

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19 245 Prenatal education courses are a common component of western antenatal care for a long  
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21 246 time, but are not offered in most maternity hospitals in China. The main purpose of a prenatal  
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23 247 education course is to support pregnant women to prepare for labour and birth and included  
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25 248 information on the labour and birth process, pain management , breastfeeding, and care of the  
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27 249 newborn (23). The prevalence of attendance of prenatal education course was 33% in Canada  
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29 250 (24) and 84% in nulliparous women in Australia (25). However, prenatal education courses  
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31 251 for pregnant women are a relatively new to our hospital (under 5 years). The current  
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33 252 percentage of attendance at our prenatal education course was 25% in our hospital and 20%  
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35 253 in our study, which is significantly lower than rates in western countries.

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38 254 Our study has found a significant reduction (35%) in the number of caesarean section on  
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40 255 maternal request in pregnant women who attended a prenatal education course. Our finding is  
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42 256 supported by other study that suggested that prenatal education courses were associated with  
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44 257 higher rates of vaginal delivery (24). In our study, maternal age, educational level, parity,  
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46 258 gravida and residence status did not influence pregnant women attending a prenatal education  
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48 259 course. Other studies have showed that prenatal education courses are more likely to be  
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50 260 attended by nulliparous women and older pregnant women (25). This higher attendance was  
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52 261 also observed in pregnant women with higher income and higher education level (23, 25).  
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54 262 The difference in factors associating with the attendance of a prenatal education course  
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3 263 between our current study and other studies could be because that our prenatal education  
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5 264 courses have only been running for 5 years in our hospital and it has not been strongly  
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8 265 recommended yet, by midwife or obstetrician. As the courses are relatively new, we hope that  
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10 266 our results will encourage obstetricians and midwives to recommend prenatal education  
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12 267 courses to pregnant women.

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14 268 Interestingly, we found that women who resided in Shanghai had a higher rate of caesarean  
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17 269 section on maternal request compared to women who did not reside in Shanghai. We do not  
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19 270 know the exact reason for this difference. Women who resided in Shanghai were significantly  
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21 271 older than women who did not reside in Shanghai by 1.2 years ( $p=0.006$ ), but there was no  
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23 272 other significant difference between two groups. As we have mentioned, further research in a  
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25 273 multicentre trial is needed to further understand the similarities and differences in pregnant  
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27 274 women characteristics and preferences in different parts of China

### 30 275 **Conclusion**

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33 276 In this study of low risk pregnant women at a tertiary hospital in Shanghai, China, we found  
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35 277 that maternal age, residence status, and attendance of a prenatal education course affect the  
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37 278 rate of caesarean section on maternal request. Attendance of a prenatal education course  
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39 279 significantly reduced the rate of caesarean section on maternal request. Our findings suggest  
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41 280 that part of China's strategy to reduce the overall caesarean rate should include prenatal  
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43 281 education courses.  
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8  
9  
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13 287  
14

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16

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20 290  
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22 291 **Declaration of Interest**  
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24 292 All authors have no conflict of interest to report.  
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27 293  
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29 294 **Data Availability**  
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31 295 The datasets used and/or analysed during the current study available from the corresponding  
32  
33 296 author on reasonable request.  
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36 297 **Contribution to authorship:**  
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38 298 All authors were involved in the drafting, editing and approval of the manuscript for  
39  
40 299 publication. In addition to this, each author contributed to follow work:  
41

42  
43 300 YG, YT: collected the data reported in this work  
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45 301 MT, YD: contributed to conception and design of this study  
46

47 302 YD, QC: designed study and wrote the manuscript draft  
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49 303 QC: completed the revised manuscript  
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52 304 **Ethics approval**  
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54 305 This study was approved by the ethics board of The Hospital of Obstetrics & Gynaecology of  
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56 306 Fudan University (Reference No. 2017-04).  
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3 372 **Figure legend**  
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5 373 Figure 1: Flow chart of data collection  
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374 **Table 1: General clinical parameters in study cohort according to the mode of delivery**

	<b>Vaginal delivery (n=304)</b>	<b>caesarean section (n=260)</b>	<b>P-value</b>
<b>Maternal age (years, median/range)</b>	32 (24-48)	33 (23-45)	<b>P=0.008</b>
<b>Parity (number, %)</b>			
1 (n=469)	258 (55%)	211 (45%)	0.24
2 (n=95)	46 (48%)	49 (52%)	
<b>Gravida (number, %)</b>			
1 (n=415)	232 (56%)	183 (44%)	0.281
2 (n=122)	59 (48%)	63 (52%)	
≥3 (n=27)	13 (48%)	14 (52%)	
<b>Education Level (number, row%)</b>			
Under tertiary (n=18)	8 (44%)	10 (56%)	0.728
Under graduate (n=450)	244 (54%)	206 (46%)	
Post graduate (n=96)	52 (54%)	44 (46%)	
<b>Residence (number, row%)</b>			
Shanghai (n=448)	229 (51%)	219 (49%)	<b>P=0.009</b>
Non-Shanghai (n=116)	75 (64%)	41 (36%)	
maternal weight before pregnancy (kg, mean/SD)	55.28±7.76	55.36±8.98	P=0.902
<b>Living conditions</b>			
Own house (n=489)	255 (52%)	234 (48%)	0.0802
Rental house (n=25)	15 (60%)	10 (40%)	
Parent's house (n=45)	31 (68%)	14 (32%)	
<b>Attendance of a prenatal education course (number, row%)</b>			
Yes (n=116)	72 (62%)	44 (38%)	<b>P=0.045</b>
No (n=448)	232 (52%)	216 (48%)	

375

377 **Table 2: Odds ratio (OR) and 95% confidence limits (CL) for the effect of maternal age,**  
 378 **residence and attendance of a prenatal education course on caesarean section rate**

	Caesarean section	Vaginal delivery	OR	95%CL	P value
<b>Maternal age (number, %)</b>					
20-29 years (n=130)	39 (30%)	91 (70%)	2.392	1.57, 3.65	<0.0001
30-39 years (n=403)	204 (51%)	199 (49%)			
<b>Maternal age (number, %)</b>					
30-39 years (n=403)	204 (51%)	199 (49%)	0.844	0.41, 1.75	0.395
≥40 years (n=31)	17 (55%)	14 (45%)			
<b>Maternal age (number, %)</b>					
20-29 years (n=130)	39 (30%)	91 (70%)	2.833	1.27, 6.31	0.009
≥40 years (n=31)	17 (55%)	14 (45%)			
<b>Residence status (number, %)</b>					
Shanghai (n=448)	219 (84%)	229 (75%)	1.749	1.14, 2.67	0.005
Non-Shanghai (n=116)	41 (16%)	75 (25%)			
<b>Attendance of a prenatal education course (number, %)</b>					
Yes (n=116)	44 (38%)	72 (62%)	0.656	0.43, 0.99	0.029
No (n=448)	216 (48%)	232 (52%)			

379



381 **Table 3: The association of age distribution and rate of caesarean section on maternal**  
 382 **request**

Age distribution	Women with caesarean section (n=260)	P value
20-29 years (number, %) (Lower CL, Upper CL)	39 (15%) (10.89%, 19.93%)	p<0.001
30-39 years (number, %) (Lower CL, Upper CL)	204 (78.5%) (72.96%, 83.3%)	
≥40 years (number, %) (Lower CL, Upper CL)	17 (6.5%) (3.85%, 10.26%)	

383 CL: confidence Limits

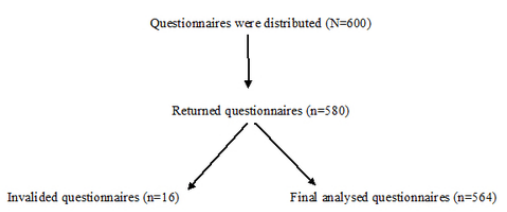
385 **Table 4: Factors associated with attendance of a prenatal education course**

	Attendance of prenatal education course		P value (Chi-square)
	Yes (n=116)	No (n=448)	
<b>Maternal age distribution</b>			
20-29 years (n=130)	24 (18.5%)	106 (81.5%)	0.708
30-39 years (n=403)	85 (21.2%)	318 (78.9%)	
≥40 years (n=31)	7 (22.6%)	24 (77.4%)	
<b>Residence (number, %)</b>			
Shanghai (n=448)	91 (20%)	357 (80%)	0.796
Non-Shanghai (n=116)	25 (22%)	91 (78%)	
<b>Education level (number, %)</b>			
Under tertiary (n=18)	2 (11%)	16 (89%)	0.328
Under graduate (n=450)	90 (20%)	360 (80%)	
Post graduate (n=96)	24 (25%)	72 (75%)	
<b>Parity (number, %)</b>			
1 (n=469)	103 (22%)	366 (78%)	0.071
2 (n=95)	13 (14%)	82 (86%)	
<b>Gravida (number, %)</b>			
1 (n=415)	91 (22%)	324 (78%)	0.297
2 (n=122)	22 (18%)	100 (82%)	
≥3 (n=27)	3 (11%)	24 (89%)	

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Figure 1



80x59mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Reported on Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	8
		(b) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	13
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9-10
		(b) Describe any methods used to examine subgroups and interactions	9-10
		(c) Explain how missing data were addressed	
		(d) If applicable, explain how loss to follow-up was addressed	
		(e) Describe any sensitivity analyses	
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	

Figure 1

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2	Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11
3			(b) Indicate number of participants with missing data for each variable of interest	
4			(c) Summarise follow-up time (eg, average and total amount)	
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7	Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12
8	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
9			(b) Report category boundaries when continuous variables were categorized	
10			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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13	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
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15	<b>Discussion</b>			
16	Key results	18	Summarise key results with reference to study objectives	13
17	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13-14
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20	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
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23	Generalisability	21	Discuss the generalisability (external validity) of the study results	16
24	<b>Other information</b>			
25	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17
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\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.