ANALYSIS OF THE TREND IN MATERNAL AGE IN CHINA FROM TWO LARGE WOMEN'S HOSPITALS BETWEEN 2003 AND 2014

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ABSTRACT

Objective: Worldwide the maternal age at birth has progressively increased over the past decades, and the advanced maternal age is associated with a number of complications of pregnancy. This trend may vary by the ethnicities and geographic regions. China has rapidly moved towards industrialisation from the 1980s, and these changes may affect the maternal age at birth. In this study we analysed the maternal age at birth over 12 years in two large women's hospitals in China**.**

Design: Retrospective study of maternal medical records.

Setting: Two large Obstetrics and Gynaecology university teaching hospitals in China.

Participants: All women with live births over twelve years.

Methods: Descriptive analysis with linear regression.

Main outcome measurements: Maternal age on 128,893 women at birth were collected and analysed.

Findings: The mean maternal age at birth was 28.3 years and significantly increased from 2003 to 2014. 91.6% of women who had birth were between 20 and 34 years, and this proportion was not changed during the study period. The proportion of women at birth over 35 years was significantly increased from 7.34% in 2003 to 9.64% in 2014, while the proportion of women at birth under 20 years was significantly reduced from 3.99% in 2003 to 0.25% in 2014.

Conclusion: The maternal age significantly increased in last decades in China and proportion of advanced maternal

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age was also increased, while the teenage pregnant rate was dropped. Our data suggest that the revolution of moving towards industrialisation from the 1980s in China may contribute to this trend.

Keywords: Maternal age; Ethnicities; China; Birth

Introduction

The maternal age at birth has progressively increased over the past decades worldwide, in particular in developed countries [1]. In addition, recently the proportion of advanced maternal age at birth (women over 35 years) has significantly increased in many developed countries, including the United States, United Kingdom and Norway [2-4], suggesting there is a clear trend in increased maternal age at birth in developed countries. However, the studies about the trends of maternal age at birth in Asian or Chinese population are limited, although a retrospective study in Taiwan showed that the maternal age at first birth was increased from 28 years in 1990 to 29.7 years in 2003 [5].

A number of studies have also demonstrated that advanced maternal age at birth is associated with a number of complications of pregnancy such as preeclampsia, gestational diabetes, preterm labour, miscarriage, Down syndrome and placenta praevia [6, 7]. The advanced maternal age at birth is also associated with the increased caesarean section rate and IVF rate [7]. We have recently shown that the advanced maternal age at birth was associated with the incidence of hydatidiform mole in Chinese women [8].

Although a number of factors have been proposed to explain the phenomenon of delayed child bearing, the increase in maternal age at birth may vary by the ethnicities, cultures and socioeconomic status. China is a

developing country and has rapidly moved towards industrialization from the 1980s. This definitely results in the changes in life environment such as work stress and life style. In addition to the one child-policy in china which was instituted since the end of 1970s, the changes in the Chinese society since 1980s may affect Chinese women in delaying childbearing. To date, studies about the trend of maternal age at birth were mainly investigated in developed countries. It is not clear whether there also is a change in maternal age at birth in Chinese women over the last decades.

The objectives of this retrospective study were to analyse the trend of maternal age at birth with a live birth in Chinese women. All the data was collected from two larger university teaching hospitals serving diverse urban and rural areas over 12 years in two different regions. We also analysed the trend of maternal age distribution at birth in this study.

Methods

This study was approved by ethic committees of the Hospital of Obstetrics & Gynaecology, Fudan University and Wuxi Maternity and Child Health Hospital, Nanjing Medical University.

Study population

Data on maternal age at birth with a live birth used in this retrospective study (n=128,893) was collected from two university teaching hospitals electronic database in two cities, each of which has a different economic status in China. All the women delivered after 28 weeks of gestation with a live birth. The two university teaching hospitals

were as follows: The Hospital of Obstetrics & Gynaecology of Fudan University, Shanghai which is a wealthy region with a population of 25 million people and Wuxi Maternity and Child Health Hospital, which is in a

prosperous region (Wuxi) with a population of 6.5 million people. In this study, data on 74,154 pregnant women from The Hospital of Obstetrics & Gynaecology of Fudan University (referred as Shanghai) from January 2003 to December 2014 and 54,739 pregnant women from Wuxi Maternity and Child Health Hospital, Nanjing Medical University (referred as Wuxi) from September 2009 to December 2014 were collected and analysed (Table 1). As the electronic database system at Wuxi Maternity and Child Health Hospital started from the middle of 2009, data before August of 2009 was not able to be collected in Wuxi Maternity and Child Health Hospital.

The Hospital of Obstetrics & Gynaecology of Fudan University is the largest women's hospital in China with more than 10,000 births a year and Wuxi Maternity and Child Health Hospital of Nanjing Medical University is the largest women's hospital in Jiangsu province with more than 10,000 births a year.

Table1: Details of participated hospitals

Participated hospital (region)	Study period	Number of birth
The Hospital of Obstetrics & Gynaecology of Fudan University (Shanghai)	January 2003 to December 2014	74,154
Wuxi Maternity and Child Health Hospital (Wuxi, Jiangsu Province)	September 2009 to December 2014	54,739

Statistical analysis

Linear regression was used to analyse the trend of maternal age with region and year as explanatory variables. The probability of maternal age 35 years old or over was analysed using logistic regression with region and year as explanatory variables. Analysis was conducted in SAS software, Version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

A total number of 128,893 pregnant women with live birth were included in this study from 2003 to 2014. Of them, 74,154 were from Shanghai during 2003 to 2014 and 54,739 were from Wuxi during 2009 to 2014 (Table 1). Overall, the mean maternal age was 28.3 (SD=4.03) years during the study period of over 12 years (Figure 1). The maternal age at birth was significantly increased from 2003 to 2014, although there was a slight drop in the maternal age at birth in 2007. The mean maternal age at birth increase by 2.83 years from 26.76 years in 2003 to 29.59 years in 2014 in Shanghai, while the mean maternal age at birth increased by 0.96 years from 2009 (27.25 years) to 2014 in Wuxi (28.21 years).

In order to investigate whether the trend of maternal age at birth varies by the regions in China, we analysed the maternal age at birth between Shanghai and Wuxi from 2009 to 2014 using linear regression adjusting for year of birth and region. Both regions had significantly increasing trend in maternal age at birth and the interaction effect of year and region was significant ($p<0.0001$) indicating the trend over the year is not the same between the two regions.

We then further analysed the two regions separately and found that the increasing trend of maternal age at birth was more prominent in Shanghai. The mean maternal age at birth was estimated to increase by 0.25 years per year in Shanghai ($p<0.0001$), while the average maternal age at birth was estimated to increase by 0.19 years per year in Wuxi ($p<0.0001$).

We then analysed the distribution of maternal age at birth in clinical relevant categories during the study period (Table 2). The majority of women (91.66%) who had birth were between 20 and 34 years. There were only 7.59% pregnant women who had birth were 35 years or over.

Table 2: Distribution of maternal age at birth during the study period (2003 to 2008 included data from Shanghai only, 2009 onward included Shanghai and Wuxi)

Year	Total	Under 20		20 - 34		Over 35	
	N	n	Row %	n	Row %	n	Row %
2003	1553	62	3.99	1377	88.67	114	7.34
2004	1706	16	0.94	1608	94.26	82	4.81
2005	2450	22	0.9	2288	93.39	140	5.71
2006	2359	50	2.12	2110	89.44	199	8.44
2007	3680	108	2.93	3338	90.71	234	6.36
2008	4518	102	2.26	4076	90.22	340	7.53
2009	5493	126	2.29	4983	90.72	384	6.99
2010	13655	122	0.89	12679	92.85	854	6.25
2011	17178	118	0.69	16010	93.2	1050	6.11
2012	20775	74	0.36	19496	93.84	1205	5.8
2013	25391	91	0.36	23022	90.67	2278	8.97
2014	30135	74	0.25	27155	90.11	2906	9.64
Total	128893	965	0.75	118142	91.66	9786	7.59

The proportion of maternal age at birth under 20 years was significantly decreased over the study period, from 3.99% in 2003 to 0.25% in 2014, while the proportion of maternal age at birth between 20 and 34 years increased slightly (88.67% in 2003 and 90.11% in 2014). The proportion of maternal age at birth at 35 years or over was significantly increased, from 7.34% in 2003 to 9.64% in 2014.

Because maternal age at birth at 35 years or over is considered as a high risk maternal age, we then compare the probability of maternal age at birth at 35 years or over between two hospitals. The proportion of maternal age at birth at 35 years or over in Shanghai increased from 7.34% in 2003 to 11.69% in 2014, while the proportion of maternal age at birth at 35 years or over in Wuxi increased from 5.38% in 2009 to 6.37% in 2014 (Table 3). Logistic regression using 2009 to 2014 data (Table 4) with region and year as explanatory variables revealed the odds of maternal age at

35 years or over in Shanghai was 40.9% significantly higher than in Wuxi (OR=1.409, 95%CI 1.35 to 1.47, p<0.0001), and each year the odds of maternal age 35 years or over significantly increased by 12.6% (OR=1.126, 95%CI 1.109 to 1.143, p<0.0001).

Table 3: Number and percentage of people with maternal age at 35 years or over from 2003 to 2014

Year		Shanghai			Wuxi	
	Total	n	Row %	Total	n	Row %
2003	1553	114	7.34			
2004	1706	82	4.81			
2005	2450	140	5.71			
2006	2359	199	8.44			
2007	3680	234	6.36			
2008	4518	340	7.53			
2009	3802	293	7.71	1691	91	5.38
2010	5344	377	7.05	8311	477	5.74
2011	7796	463	5.94	9382	587	6.26
2012	9009	509	5.65	11766	696	5.92
2013	14802	1546	10.44	10589	732	6.91
2014	17135	2003	11.69	13000	903	6.95
Total	74154	6300	8.5	54739	3486	6.37

Table 4: Logistic regression for maternal age at 35 years or over as outcome with region and year as explanatory variables (year 2009 to 2014)

Effect	Odds Ratio	95% Wald	Confidence Limits
Shanghai vs Wuxi	1.409	1.347	1.473
Year (1 year increase)	1.126	1.109	1.143

Discussion

There is a growing trend in maternal age at birth occurring later in women's life worldwide, although biologically the optimum period for birth is between 20 and 35 years old. The Changes in maternal age at birth may be associated with the geographic regions. The mean maternal age at birth in the United States, United Kingdom and Canada was 25.6, 28.1 and 29 years, respectively in 2011, which was significantly increased from last decades [9]. In Asian countries, the mean maternal age at birth was 30.3 years in Japan in 2012 and 30.3 years in South Korean in 2011. A recent study from Taiwan also reported that the mean maternal age at first birth was increased from 28 years in 1990 to 29.7 years in 2003 [5]. Consistent with other ethnicities, in our current study, we report that the mean maternal age at birth over the study period was 28.3 years, and was significantly increased from 2003 (26.76 years in

Shanghai) to 2014 (29.59 in Shanghai and Wuxi) in our study populations in the two study regions. In this study we also found that the mean maternal age at birth was significantly increased by 0.25 years per year in Shanghai. This increase in maternal age at birth was higher than that in Wuxi (0.19 years per year), suggesting there is a difference in changes of maternal age at birth in different regions in China. This could be because Shanghai is the largest industrialised and wealthy city in China, and the life environment and style and economic status significantly differ to Wuxi. Our recent unpublished survey reported 80% pregnant women have high education level (above Bachelor degree) and 94 pregnant women are currently employed in Shanghai. These data may suggest an association between social economic status and delay child-bearing in Shanghai.

There are many reasons for women starting to delay child-bearing. A survey study suggested approximately 50% women considered their financial security and career before having a child [10]. Other recent study investigated in Netherland suggested that the increases in women's education, labour market involvement by women and economic uncertainty are the top reasons for women delaying having a child [11]. We do not know the exact reasons for Chinese women delaying child-bearing. One of the main reasons could be that China has rapidly moved towards industrialisation from the 1980s and this revolution reflects that women or young families want to expand their career options, and to have higher education qualification as well as feel financial pressure to have a child [12].

Another possible reason is that women start to delay their marriage age due to the changes in China. A Chinese survey indicated the average marriage age for women is 28.4 years in 2006 in Shanghai. All these may suggest that life environmental, educational and professional aspirations may contribute to women delaying child-bearing [10].

A study has shown that the distribution of maternal age at birth also changed and it varies by ethnicities [4]. The proportion of maternal age at birth between 20 and 34years was slightly increased from 69.5% in 2000 to 73% in 2010 in the United States [4]. A study from Taiwan reported that 85% of women having their first child was between 20 and 34 years [5], however that study did not analyse the trend of maternal age at birth during the study period of 14 years. In our current study we found that the majority of women (91.66%) who gave birth were between 20 to 34 years in our study population during the study period of over 12 years and interestingly there was no change in this proportion during the study period of over 12 years. This result may suggest that the majority of women in China do not consider the changes in social and life environment to have a child.

The proportion of women who have birth at 35 years or over is increased in many developed countries over the last decades, including Canada, Western Europe, the United States, Australia and New Zealand [4, 7]. A study reported that the proportion of maternal age at birth at 35 years or over was 9% between 2010 and 2011in China [13]. However, the trend of maternal age at birth in China has not fully investigated. In this study, our data found only 7.6% of women who had child at 35 years or over, which is lower than in USA reported in the literature [4]. We also found that the proportion of maternal age at birth at 35 years or over was significantly increased from 7.34% in 2003(Shanghai) to 9.64% in 2014 (Shanghai and Wuxi), which is slightly higher than that in the United States (7.4% in 2000 and 8.2% in 2010) [4]. Our data may suggest the increased number of Chinese women start to have a child in advanced age. In our current study we also found that the proportion of women with birth at 35 years or over including yearly increase rate was significantly higher in Shanghai than that in Wuxi. This further suggests that the life environment and social economic levels may affect women to have a child in China.

Teenager pregnancy rates are quite high in western countries such as the United States, United Kingdom, New Zealand (http://www.TeAra.govt.nz/en/graph/30862/teenage-pregnancy-international-comparisons), although this rate has been declined recently. A recent study reported that the birth rates for teenagers was declined from 4.2% in 2007 to 2.4% in 2014 in United States [14]. In our current study we found that the birth rates for teenagers in our study population were much lower than in the United States, and it also significantly declined from 0.93% in 2004 to 0.25% in 2014.

Teenager pregnancy might be higher in rural regions in China (http://www.chinadaily.com.cn/china/201607/13/content_26078096.htm and http://www.scmp.com/news/china/society/article/1919454/southern-chinasmashan-county-teen-pregnancies-and-underage), but the lower teenage pregnancy rate in our study population seen in this study compared to western countries could be because of Chinese traditional culture and family higher expectation of their children and because of the data in this study were collected from two wealthy cities in China.

The nearly 40 year's one-child policy, as part of family planning policy has ended in China in 2015. It has been speculated that this change will increase the maternal age in the future as many mothers under one-child policy want to their second baby. It will be interesting to investigate the maternal age in future and the association of increased maternal and pregnancy complications in China.

There are some limitations of our analysis in this study. First, not all the maternal age at birth reported in this study was first birth. However, due to the one child policy started at the end of 1970s in China and in practice this policy was strictly implemented in large cities, such as Shanghai, the majority of women included in this study were first time to give birth. Second, due to the data included in this study was collected from two major university teaching women's hospitals in two cities, it may not be fully representative of China as a whole.

Conclusion

In this study we report that the maternal age at birth in our study population was 28.3 years and significantly increased from 2003 to 2014. We also found that the proportion of women with birth at 35 years or over was increased from 7.34% in 2003 to 9.64% in 2014. Although the majority of women did not change the maternal age, more women delayed to give a birth. The revolution of moving towards industrialisation from the 1980s in China and the Chinese culture may contribute to this trend.

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