



# BMJ Open Medical expenditure of women during pregnancy, childbirth and puerperium at the beginning of China's universal two-child policy enactment: a population-based retrospective study

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## ABSTRACT

**Objectives** To describe and explore women's medical expenditures during pregnancy, childbirth and puerperium at the beginning of the universal two-child policy enactment in China.

**Design** Population-based retrospective study.

**Setting** Dalian, China.

**Participants** Under the System of Health Accounts 2011 framework, the macroscopic dataset was obtained from the annual report at the provincial and municipal levels in China. The research sample incorporated 65 535 inpatient and outpatient records matching International Classification of Diseases, 10th Revision codes 000–099 in Dalian city from 2015 through 2017.

**Primary and secondary outcome measures** The study delineates women's current curative expenditure (CCE) during pregnancy, childbirth and puerperium at the beginning of the universal two-child policy in China. The temporal changes of medical expenditure of women during pregnancy, childbirth and puerperium at the beginning of China's universal two-child policy enactment were assessed. The generalised linear model and structural equation model were used to test the association between medical expenditure and study variables.

**Results** Unlike the inverted V-shaped trend in the number of live newborns in Dalian over the 3 studied years, CCE on pregnancy, childbirth and puerperium dipped slightly in 2016 (¥260.29 million) from 2015 (¥263.28 million) and saw a surge in 2017 (¥288.65 million). The ratio of out-of-pocket payment/CCE reduced year by year. There was a rapid increase in CCE in women older than 35 years since 2016. Length of stay mediated the relationship between hospital level, year, age, reimbursement ratio and medical expenditure.

**Conclusions** The rise in CCE on pregnancy, delivery and puerperium lagged 1 year behind the surge of newborns at the beginning of China's universal two-child policy. Length of stay acted as a crucial mediator driving up maternal medical expenditure. Reducing medical expenditure by shortening the length of stay could be a feasible way to effectively address the issue of cost in women during pregnancy, childbirth and puerperium.

## Strengths and limitations of this study

- This is a large population-based study with a randomly selected sample of women's medical expenditure during pregnancy, childbirth and puerperium.
- At the beginning of China's universal two-child policy enactment, maternal medical expenditure lagged after the rise in childbirth by 1 year.
- The study discovered that length of stay mediated the relationship between hospital level, year, age, reimbursement ratio and maternal medical expenditure.
- Limited by data sources, other unevaluated factors could affect results.
- The setting was confined to only one city, limiting the generalisability of our findings to other regions.

## INTRODUCTION

In the late 1970s, to control the rapid population growth, the Chinese government introduced the one-child family planning policy. However, decades after enacting the one-child policy in China, population constraints have shifted from overpopulation to structural pressure stemming from skewed age distribution. To achieve demographic equilibrium, the universal two-child policy was implemented in January 2016. Its regulatory effect was very significant in the early stage after policy adoption. According to the National Bureau of Statistics of China, the newborn baby population saw a sudden surge in 2016, reaching a 17-year high since 2000, then edged down in 2017 and has taken a surprisingly sharp drop since 2018.<sup>1</sup>

Evidence suggests that fertility rates are dropping over time in most developed and many developing countries: close to half of the world's population lives in a country or area where lifetime fertility is below 2.1 live



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births per woman.<sup>2</sup> As a result, a growing number of countries are rolling out government policies and programmes to increase fertility.<sup>3</sup> The adjustment of fertility policy may have effects on the health system, and especially the health economy. Therefore, there is a compelling need to understand the probable health/social scenarios introduced by adjusting fertility policies.

There are many changes in pregnancy and maternity characteristics after adjustment of the universal two-child policy in China. The proportion of pregnant women over 40 years at high risk of many pregnancy complications and preterm birth increased after 2016.<sup>4</sup> The prevalence of some age-related anomalies also ticks up since then.<sup>5</sup> With the shift of decision-making regarding delivery mode, the caesarean delivery rate saw a rise among multiparous mothers versus a drop among nulliparous women.<sup>6</sup> Maternity-related changes following fertility policy adjustments may present potential challenges to the health economy. Specifically, the changing mode of delivery, the number of births, obstetric complications and pregnancy-associated diseases may cause a mix of obstetric-related medical expenditure changes in this particular period. However, how the specific medical expenditure changes during the shift of the universal two-child policy lacks relevant research.

Previous research on China's universal two-child policy focused heavily on evaluating demographic changes,<sup>7</sup> maternal health,<sup>8</sup> birth-related health factors,<sup>9</sup> characteristics of pregnancy and delivery,<sup>10 11</sup> and adjustment of health services.<sup>12</sup> A recent study reported that health expenditure in Chinese women of childbearing age was primarily incurred during pregnancy, delivery and puerperium.<sup>13</sup> However, there is little research on the characteristics and influencing factors of women's medical expenditure during pregnancy, childbirth and puerperium, and especially during the universal two-child policy adjustment. Understanding the characteristics of medical expenditures related to delivery helps to better analyse the relevant socioeconomic issues and social phenomena during family planning policy adjustment.

The numbers of newborns in Dalian were 45 714 in 2015, 69 544 in 2016 and 60 265 in 2017, enjoying a similar variation occurring in nationwide live birth numbers.<sup>14</sup> The current study is set in Dalian (a coastal city in Liaoning province of China's northeast region) and examined the medical expenditure and factors associated with women's childbearing medical expenditure during pregnancy, childbirth and puerperium at the beginning of the introduction of China's universal two-child policy. This study aimed to analyse the reproductive medical economy issues surrounding China's universal two-child policy.

## METHODS

### The framework accounting for the current curative expenditure

This study described city-level medical expenditure based on the System of Health Accounts 2011 (SHA 2011).<sup>15</sup>

SHA 2011 is a universally applicable health financial framework that provides a tool to track health expenditure consumed by a country or region over 1 year or more. It also keeps tabs on such issues as where the money comes from and for what it is used.<sup>16</sup> Therefore, it can capture financial trends related to healthcare. SHA 2011 separates current curative expenditure (CCE) from the capital structure in healthcare (eg, hospital buildings, ambulances and medical imaging machines). Accordingly, it reflects the characteristics of patients' direct health expenditure more accurately. SHA 2011 methodology can also provide an accounting for the CCE by clinical diagnosis and age groups. Under the framework of SHA 2011, this study delineated financing schemes, financial flows and the distribution in different age groups for women's medical expenditures during pregnancy, childbirth and puerperium from 2015 to 2017.

### Data sources

The study data included two parts. The first part was the macroscopic dataset at the city level, which was obtained from the annual report at the provincial and municipal levels. These data were extracted from Dalian health statistical yearbook (2015–2017), Dalian health financial annual report (2015–2017), Dalian statistical yearbook (2015–2017), and Liaoning health and family planning statistical yearbook (2015–2017). The yearbooks and annual reports were obtained from the Health Commission of Dalian. The second part was the sample-level data on patients' medical expenses, demographic and clinical information, which came from sampled medical institutions in Dalian city.

### Sample method and sample size

The sample institutions in this study were randomly selected from Dalian using multistage stratified sampling and the probability proportional to size method. The sample proportion was set at a ratio of 30%. Five stages were included in this sampling procedure. In the first stage, the municipal-level hospitals in the city were picked by random sampling. In the second stage, six districts and three counties were extracted as sample areas based on economic level (gross regional product), medical conditions (health resources and health service level) and geographical location. For the third stage, district-level hospitals and county-level hospitals were randomly selected using the lottery method. The fourth stage was to choose streets from each selected district and extract communities (urban neighbourhood or rural village) from selected streets. The fifth stage was to determine primary healthcare institutions at all levels (ie, community health service centre, township health centre, community health service station and village clinic) in the sampled areas. Then the above institutions were randomly selected by the type under the preset sampling ratio of 30%. The year 2015 was the first sampling year. To achieve the samples' full representativeness, the institutions were selected by expanding the numbers up to the nearest higher integers

in each step if the computed value was not an integer. After the first sampling year, samples were drawn with the actual calculated values rounded off to the nearest integers in each sampling step. Once complete, 565, 496 and 456 medical institutions were sampled in 2015, 2016 and 2017, respectively. The data of women during pregnancy, childbirth and puerperium were collected from the sampled medical institutions.

The collected data included diagnosis, age, admission and discharge dates, length of stay, total and detailed expenditure of treatment (drug expenses, diagnostic and laboratory test expenses, surgery costs, nursing expenses, spending on blood, etc), out-of-pocket (OOP) payments, insurance type, reimbursement ratio, medical institution level and type of medical institution. All information that could be used to distinguish individuals' identity was coded and anonymised.

### The indicator system

Health financing reflects the source of funds. Three sources of financing schemes constitute CCE in mainland China: public financing scheme, voluntary financing scheme and OOP payments. The public financing scheme is formed by social health insurance and government financing scheme. Voluntary health insurance programmes and enterprise financing plans make up the voluntary financing scheme. OOP payments are calculated by the total health expenditure minus insurance reimbursement.

### Quality control and data management

Diagnoses were recorded according to the International Classification of Diseases, 10th Revision (ICD-10), and this study included ICD-10 codes O00–O99. The sample data were visually inspected by two researchers and subsequently cleaned using Microsoft Excel (Excel 2013, Microsoft Corporation, Redmond, Washington, USA) before data analysis. Missing, incomplete or unreasonable records were returned to the source institutions for verification and then resubmitted. For various reasons (eg, incomplete clinic or electronic register data, data entry errors), some abnormal or missing records still existed in the corrected database. After removing 950 unqualified records from the dataset, the final sample size was 65 535. Among these, 32 390 records were from inpatient data, and 33 145 records were from outpatient data.

### Patient and public involvement

No patients or members of the public were directly involved in the study.

### Statistical analysis

We compared CCE in different health financing schemes over the 3 years at the district level. The formula for calculating the CCE in this study was based on the manual co-edited by the Organization for Economic Co-operation and Development, the European Union and the WHO.<sup>15</sup> For a more intuitive representation, a Sankey diagram

was created to characterise the dynamic flow of CCE from different financing schemes to diverse health institutions.

For the sample dataset, descriptive analyses included medians and IQRs for continuous variables. Categorical variables were presented in terms of number and percentages. We explored the association between medical expenditure and study factors from all pooled data. The Shapiro-Wilk test was used to examine data normality. Results indicated that the patients' medical expenditure was not normally distributed. As inpatient expenditure accounted for the largest portion of CCE, this study analysed medical expenditure with inpatients in depth. Non-parametric Kruskal-Wallis H tests followed by Dunn-Bonferroni post hoc pairwise comparisons were applied to compare inpatient expenditure among multiple groups by hospital level and type. Generalised linear models were used to evaluate the effects of the study variables on medical expenditure. Categorical variables were converted into sets of dummy variables. Optimal models were obtained using backward stepwise selection.

We conducted structural equation modelling to examine the simultaneous latent relationship between the study variables and medical expenditure. This study used  $\chi^2/\text{df}$ , the goodness-of-fit index (GFI), the comparative fit index (CFI), the normed fit index (NFI), the relative fit index (RFI), the incremental fit index (IFI), the Tucker-Lewis index (TLI) and the root mean square error of approximation (RMSEA) to verify the model fit. According to conventional criteria, a good model fit is achieved with  $\chi^2/\text{df}$  below 3.00, GFI, CFI, NFI, RFI, IFI and TLI above 0.90, as well as RMSEA below 0.05.<sup>17</sup>  $\chi^2$  is sensitive to the sample size. Although there is some decrease in dependency when it is divided by df,  $\chi^2/\text{df}$  is also dependent on the sample size.<sup>18</sup> When there is a large sample size, relatively loose confinement of  $\chi^2/\text{df}$  is acceptable.<sup>19 20</sup>

Statistical analyses were performed with SPSS Statistics for Windows, V.22.0 (IBM Corp); R, V.3.4.3 (The R Foundation; <http://www.r-project.org>); EmpowerStats software ([www.empowerstats.com](http://www.empowerstats.com), X&Y solutions, Boston, Massachusetts, USA); and AMOS software, V.20.0 (SPSS, Chicago, Illinois, USA). All statistical tests were two sided, and  $p < 0.05$  was considered statistically significant.

## RESULTS

### CCE of women during pregnancy, childbirth and puerperium in Dalian from 2015 through 2017

During pregnancy, childbirth and puerperium, CCE for women in Dalian was ¥263.28 million in 2015, ¥260.29 million in 2016 and ¥288.65 million in 2017. The government financing scheme, voluntary financing scheme, OOP payments and CCE in 2016 dipped slightly from 2015 before bouncing up to a 3-year high in 2017. The social health insurance edged up in 2016 from its level in 2015 and saw a spike in 2017: ¥109.33 million in 2015, ¥110.85 million in 2016 and ¥123.20 million in 2017. The ratio of OOP payment/CCE was on a downward trend



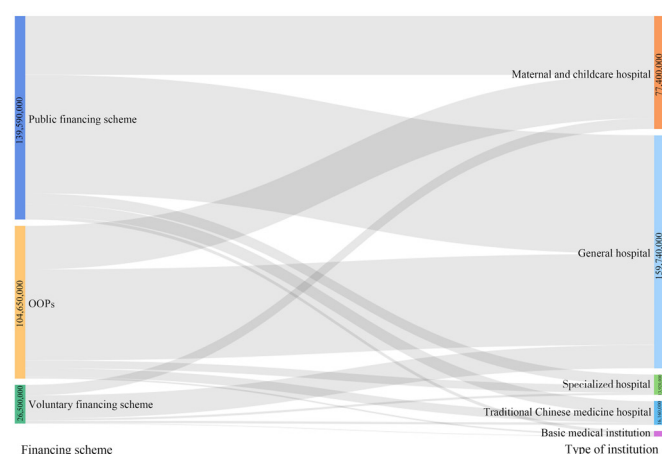
**Table 1** The health financing of women during pregnancy, childbirth and puerperium in Dalian city (million ¥)

Year	CCE	Public financing scheme		Voluntary financing scheme		OOP payments	Ratio of OOP payment/CCE (%)	Ratio of public financing scheme/CCE (%)
		Social health insurance	Government financing scheme	Voluntary health insurance programme	Enterprise financing plan			
2015	263.28	109.33	23.81	10.59	16.18	103.37	39.26	50.57
2016	260.29	110.85	22.49	10.35	14.87	101.74	39.09	51.23
2017	288.65	123.20	29.13	10.72	16.74	108.86	37.71	52.77

CCE, current curative expenditure; OOP, out-of-pocket.

during the 3 studied consecutive years, at 39.26% in 2015, 39.09% in 2016 and 37.71% in 2017. An opposite trend was observed for the ratio of public financing scheme/CCE (table 1). CCE of the 3 studied years totalled ¥812.22 million, with the inpatient expenditure constituting a preponderance of 74.92%, at ¥608.49 million, and the outpatient expenditure accounting for the remaining 25.08%, at ¥203.73 million. The average exchange rates for 2015, 2016 and 2017 were ¥6.23, ¥6.64 and ¥6.75 per US dollar, respectively.

In this study, health institutions were categorised into five classes according to the scope of service: general hospital, maternal and childcare hospital, specialised hospital, traditional Chinese medicine hospital and basic medical institution (community health service centre, community health service station, township health centre and village clinic). The Sankey diagram in figure 1 illustrated the average CCE in 2015–2017 flowing from different financing schemes to diverse health institutions. Women during pregnancy, childbirth and puerperium had the highest expenditure, mainly in general hospitals (accounted for 59.00%) and maternal and childcare hospitals (accounted for 28.59%). Basic medical institutions accounted for only 1.30% of CCE. OOP payments accounted for 38.65% of the all-in cost.

**Figure 1** Sankey diagram of the average CCE in 2015–2017 flowing from different financing schemes to diverse health institutions. CCE, current curative expenditure; OOP, out-of-pocket.

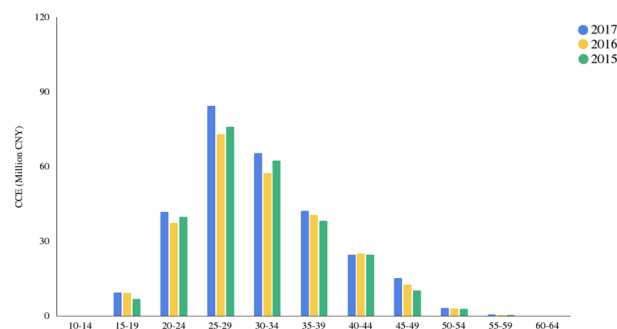
### CCE of women during pregnancy, childbirth and puerperium in different age groups

CCE on pregnancy, childbirth and puerperium climbed up from the age group 15–19 years, peaked in the age group 25–29 years, then dropped gradually at higher ages. CCE of all age groups was higher in 2017 than in 2015. For the group aged 35–54 years, CCE was higher in 2016 than in 2015. However, for the age group under 34 years, CCE was higher in 2015 than in 2016 (figure 2).

### Factors associated with inpatient expenditure

As inpatient expenditure represented the majority of CCE, in-depth analyses of medical expenditure were conducted for inpatients. Univariate analysis revealed significant differences in inpatient expenditure by hospital level, type and year ( $p < 0.001$ ), with post hoc pairwise comparisons of all possible combinations being significant (all  $p < 0.001$ ) (table 2).

A generalised linear model with medical expenditure as the outcome and with hospital level, hospital type, year, length of stay, reimbursement ratio and age as independent variables was run. All these factors were entered into the final model except the factor of age. The model was significant (Akaike Information Criterion (AIC)=659179.430, log-likelihood=-329577.715,  $df=12$ ,  $R^2=0.1260$  (adjusted  $R^2$  was 0.1257), and residuals  $SD=6353.006$  (Pearson  $\chi^2$  normality test  $p < 0.001$ )). Table 3 presents the econometric results of the generalised linear model for medical expenditure. Seeking medical help for pregnancy and childbirth in provincial

**Figure 2** The proportion of CCE for each age group stratified by years. CCE, current curative expenditure; CNY, Chinese yuan.

**Table 2** Median expenditure and group differences for inpatients (N=32 390)

Variables	Variable abbreviations	n	Inpatient expenditure Median (IQR)	H	P value	Post hoc test* (adj. sig)
Hospital level	HL			183.175	<0.001	HL4>HL2 (p=0.002); HL4>HL3 (p<0.001); HL1>HL4 (p<0.001); HL1>HL2 (p<0.001); HL1>HL3 (p<0.001)
Provincial	HL1	708	7468.01 (5362.22–12 642.35)			
Municipal	HL2	16 919	5262.20 (3150.17–9053.13)			
District	HL3	7924	5208.75 (3124.89–8885.33)			
County	HL4	6839	5505.53 (3850.45–6346.63)			
Hospital type	HT			1678.642	<0.001	HT1>HT2 (p<0.001); HT3>HT2 (p<0.001); HT4>HT2 (p<0.001); HT2>HT1 (p<0.001); HT3>HT1 (p<0.001); HT4>HT1 (p<0.001)
Specialised hospital	HT1	3052	3673.14 (566.66–7320.34)			
Traditional Chinese medicine hospital	HT2	2188	4145.63 (2883.82–5884.92)			
Maternal and childcare hospital	HT3	10 665	5375.32 (3488.39–6419.05)			
General hospital	HT4	16 485	6053.01 (3634.96–9898.26)			
Year	Y			2093.309	<0.001	
2015	Y1	17 464	5243.21 (3119.24–7615.38)			Y1>Y2 (p<0.001)
2016	Y2	4185	3656.04 (2713.35–5440.71)			Y3>Y1 (p<0.001)
2017	Y3	10 741	6293.51 (4275.12–9984.97)			Y3>Y2 (p<0.001)

\*Post-hoc test: Dunn-Bonferroni pairwise comparison.

or district hospitals, and in general hospitals, in the year 2017, and with longer hospital stay, was associated with higher expenditure.

### Modelling and model estimates

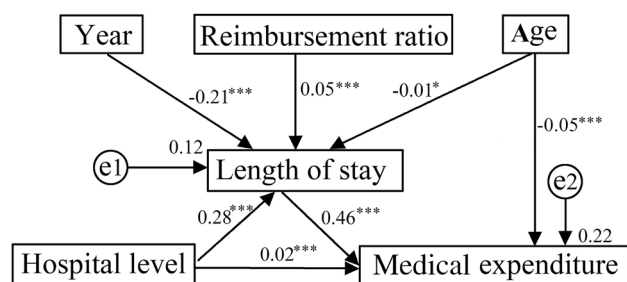
We constructed a structural equation model to explore the direct and indirect relationship of variables on medical expenditure (inpatient and outpatient expenditure) (figure 3). The structural equation model demonstrated a good fit to the data with GFI=0.999, CFI=0.991, NFI=0.991,

**Table 3** Summary of the estimated coefficients for explanatory variables

Variables	Estimate	SE	t value	95% Wald CI		P value
				Lower	Higher	
Intercept	8244.545	144.519	57.048	7961.286	8527.803	<0.001
Hospital level						
Provincial	935.853	268.257	3.489	410.067	1461.638	<0.001
Municipal	115.775	107.034	1.082	−94.012	325.561	0.279
District	1072.700	128.280	8.362	821.271	1324.129	<0.001
County*	0†					
Hospital type						
Specialised hospital	−1851.923	134.112	−13.809	−2114.783	−1589.064	<0.001
Traditional Chinese medicine hospital	−2750.444	154.829	−17.764	−3053.910	−2750.444	<0.001
Maternal and childcare hospital	−2688.849	98.955	−27.173	−2882.800	−2494.898	<0.001
General hospital*	0†					
Year						
2015	−2865.814	85.143	−33.659	−3032.693	−2698.934	<0.001
2016	−4494.304	125.227	−35.889	−4739.748	−4248.860	<0.001
2017*	0†					
Length of stay	256.313	8.103	31.633	240.432	272.194	<0.001
Reimbursement ratio	−607.055	144.483	−4.202	−890.241	−323.869	<0.001

\*Reference value.

†This parameter is set to zero because it is redundant.



**Figure 3** Path diagram of the structural equation modelling for medical expenditure.

RFI=0.977, IFI=0.991, TLI=0.978 and RMSEA=0.020. Considering that the structural equation model was run with a large sample size of 65 535, the values  $\chi^2=221.983$ ,  $df=8$  and  $\chi^2/df=27.748$  were deemed acceptable. This model accounted for 21.80% of the total variance in medical expenditure. The length of stay was negatively associated with the year ( $\beta=-0.21$ ,  $p<0.001$ ) and positively affected by the reimbursement ratio ( $\beta=0.05$ ,  $p<0.001$ ). Length of stay ( $\beta=-0.01$ ,  $p=0.039$ ) and medical expenditure ( $\beta=-0.05$ ,  $p<0.001$ ) were negatively associated with age. Furthermore, length of stay ( $\beta=0.46$ ,  $p<0.001$ ) and hospital level ( $\beta=0.02$ ,  $p<0.001$ ) had direct positive paths on medical expenditure. Meanwhile, the hospital level directly weighed on the length of stay ( $\beta=0.28$ ,  $p<0.001$ ). That is, the hospital level not only had a direct effect on medical expenditure but also had an indirect effect on medical expenditure through the length of stay.

## DISCUSSION

This study demonstrated that China's universal two-child policy shift took a substantial weight on CCE on pregnancy, childbirth and puerperium. Based on the SHA 2011 framework, the financial flows were described systematically and allowed an accurate comparison of health expenditure across the years. We discovered an interesting phenomenon: unlike the inverted V-shaped trend in the number of live newborns in Dalian over the 3 studied years, CCE on pregnancy, childbirth and puerperium dipped slightly in 2016 from 2015 and saw a surge in 2017—indicating that CCE hike lagged 1 year behind the newborn hike. For women older than 35 years, CCE in each group showed an upward trend after 2016. Medical expenditure was associated with length of stay, hospital level, hospital type, year of treatment, maternal age and reimbursement ratio. The identified relationship between associated factors may help explore the reducing health expenditure and targets for policy adjustment.

One finding of this study was that while CCE on pregnancy, childbirth and puerperium climbed in 2017, the ratio of public financing scheme/CCE rose year by year, and the rate of OOP payment/CCE fell yearly. In response to the United Nations' Millennium Development Goals,

many countries have made great efforts to improve maternal and children's healthcare.<sup>21</sup> China has taken multiple actions to improve maternal health and reduce OOP payments. As public health expenditure is more likely than private health expenditure to affect a larger proportion of the population,<sup>22</sup> the Chinese government implemented various measures in recent years, including but not limited to adding free antenatal screening and increasing maternity insurance coverage. From the health economic perspective of this study, structure of health financing is stepping in the right direction. Women of childbearing age may benefit.

There was a surge in the number of live newborns in 2016.<sup>14</sup> Presumably, CCE was meant to follow the tide in the same year, but this study found that CCE edged down from 2015 and saw a hike 1 year later. Our other study confirmed that delivery CCE rose in the wake of the newborn surge, not 1 year later.<sup>23</sup> CCE in this study included the cost of delivery, prenatal and puerperium healthcare expenditure. Compared with delivery services, prenatal services are relatively cheap.<sup>24</sup> Meanwhile, some free prenatal care has been incorporated into China's national basic public health service programme and has accordingly lowered antenatal medical expenditures. Advanced maternal age is considered a dominant risk factor for worse perinatal outcomes,<sup>25</sup> which may increase the risk of medical expenditure in the particular study period. Accordingly, these factors may have conspired to contribute to the outcome.

In this study, CCE of women older than 35 years increased year by year, hinting that there was an increase in fertility behaviour and associated reproductive expenditure at the advanced-aged women at the initiation of China's universal two-child policy. This may be surmised from the following points. First, most of these women already had a child, and their wish for a second child was long overdue. Second, women's fertility is strongly linked to age. Women aged 35 years or older have significant uncertainty in their diminished reproductive potential,<sup>26</sup> and may be more sensitive to the narrowing chance of childbearing. According to the theory of planned behaviour, a positive belief and attitude toward one thing would promote the intention to take action.<sup>27</sup> When the women intend to have a second child, they will jump at the opportunity if the policy allows.

This study found a significant difference in medical expenditure according to the hospital level and type when concentrated on sampled inpatients. High-level hospitals are abundant in medical resources and have advanced technology and better medical teams. However, high-level hospitals' charges are higher, and the reimbursement ratio is lower than low-level hospitals in China. A previous study showed that Chinese patients' preference for hospitals is related to their trust level.<sup>28</sup> The low quality of healthcare provided by some low-level hospitals undermines people's trust in those services, which subsequently render people to opt for high-level hospitals. Additionally, inpatients receiving treatment in general hospitals

had higher medical cost than in other types of hospitals. General hospitals are usually provincial-level (or at least city-level) institutions, which generally represent higher quality medical care which other types of facilities fail to approach. Therefore, general hospitals handle most of the high-risk deliveries (eg, pre-eclampsia/eclampsia, placenta previa, placental abruption). Some severely ill patients are often referred from low-level institutions or initially choose high-level hospitals for more safety and professional treatment.<sup>29</sup> Severe and deadly diseases are probably contributing to extended hospitalisation and increased cost.

This study determined that the path coefficient of age on medical expenditure and the length of stay was negative in the structural equation model. However, the path coefficient value was very low. Although various studies have demonstrated that medical costs increase with age for obstetric complications,<sup>30,31</sup> the evidence does not line up neatly. A recent survey in childbearing women coincided with ours in finding that the length of stay after childbirth decreases with women's age.<sup>32</sup> This accordingly reduced delivery cost. Meanwhile, primipara usually experiences more anxious and prolonged delivery than multipara,<sup>33</sup> which may extend the length of stay before and after birth. The disparities in the results mentioned above may come courtesy of the heterogeneity of the samples.

Our results also highlighted that the length of stay was a significant mediating variable in the relationship between year of treatment, reimbursement ratio, hospital level and medical expenditure. A study on obstetric complications showed that prolonged hospital stay leads to increased hospital expenditures.<sup>34</sup> Length of stay is an important index to measure hospital quality and management, and various policies were adopted to shorten the length of stay in Chinese hospitals in the study period.<sup>35</sup> Most high-level hospitals strive to cut the length of stay and create profits by accelerating patient turnover rates and using more advanced medical technology.<sup>36</sup> Furthermore, our results were consistent with a longitudinal study showing that the trajectory of the length of stay was roughly dependent on that of the reimbursement ratio, with those enjoying a higher reimbursement ratio having longer stay.<sup>37</sup> Inpatients with a high reimbursement ratio also had less OOP payments. Thus, they are more likely to increase the unnecessary length of stay or examinations. The result confirms that it is the right choice for China's cost-control policies to curtail the excessive length of stay and promote the leveraging effect of health insurance while maintaining care quality.

## Limitations

This study has a few limitations. First, the study data were derived from Dalian city and thus may not be nationally representative. Second, due to limited sample information, we cannot probe into such factors as the severity of illness and treatment regimen, which might be associated with medical expenditure. Third, this study measured medical expenditure in the period of pregnancy,

childbirth and puerperium with hospitals as the sampling units, without considering the continuity at individual level.

## CONCLUSIONS

This study provides comprehensive evidence on health expenditure during China's family planning policy adjustment. Despite increases in CCE after the policy shift, the ratio of OOP payment/CCE was trending down, underlining the ongoing role of government assistance for the health economy. Furthermore, the rise in CCE on pregnancy, delivery and puerperium lagged 1 year behind the surge of newborns after introducing the universal two-child policy in China. Identifying the health expenditure trajectory and financing resultant may provide valuable direction for health policy. Length of stay played a crucial mediating role in adjusting women's medical expenditure, shedding light on the prospect of making it a breakthrough in health reform for containing medical expenditure.

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