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ORIGINAL ARTICLE

Association of preconceptional health care utilization and early initiation of prenatal care

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Objective: To assess whether women having preconceptional health care utilization were more likely to have early initiation of prenatal care than were women not having preconceptional health care utilization.

Study Design: In this cohort study, data were collected prospectively from a population-based Perinatal Health Care Surveillance System in China. The analysis included 195 796 women who delivered single live births in 13 cities/counties during 1997 to 2000. Mantel–Haenszel test was employed to calculate risk ratios and 95% confidence intervals (CI). Multivariate logistic regression was conducted to assess the association between preconceptional health care utilization and early initiation of prenatal care after controlling for maternal residence, age at delivery, educational attainment, occupation, parity, preconceptional medical disorders, and high-risk medical experiences during the first trimester. SPSS 11.5 (SPSS Inc.) was employed for data analysis.

Results: Women having preconceptional health care utilization were 2.6 times (95%CI: 2.5 to 2.6) more likely to have early initiation of prenatal care compared with women not having preconceptional health care utilization. When stratified by maternal residence, age at delivery, educational attainment, occupation, parity, preconceptional medical disorder, high-risk medical experiences during the first trimester, and preconceptional medical disorders, this association still existed. After controlling for stratification factors mentioned above and the interaction of maternal age, educational attainment, and parity, women having preconceptional health care utilization were 2.7 times (95%CI: 2.6 to 2.8) more likely to have early initiation of prenatal care than were women not having preconceptional health care utilization.

Conclusion: Women who had preconceptional health care utilization were more likely to have early prenatal care than were women not having preconceptional health care utilization.
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Introduction

Many experts have strongly recommended that pregnant women should begin prenatal care during the first trimester to receive timely risk assessment or education.[1,2] The timing of prenatal care initiation can be influenced by numerous prepregnancy factors, including maternal educational attainment,[1–6] age,[1–8] parity,[2,6,7] ethnicity,[3] women's feeling about pregnancy and prenatal care,[6] and insurance.[2,8–11]

In the last two decades, some investigators have demonstrated the importance of preconceptional care to improve perinatal outcomes. For example, it has been demonstrated that addressing periconceptional folic acid use at a preconceptional consultation improves folate use among women planning to conceive.[12] Additionally, prepregnancy care of diabetic women has been proven to be associated with a highly significant reduction in the risk of serious congenital abnormalities in the offspring.[13]

However, few investigators have examined the association between preconceptional health care utilization and timing of prenatal care. Therefore, we conducted our study in order to test the hypothesis that preconceptional health care utilization can promote early initiation of prenatal care.

Materials and methods

Data source and study population

Data were from a population-based Perinatal Health Care Surveillance System that was established by Institute of Reproductive and Child Health, Peking University. In surveyed areas, all women who plan on being married or pregnant as well as their neonate are included in the system and followed up until the 42th day after delivery by health professionals. The information collected via this system covers maternal demographic characteristics, preconceptional health status and health care utilization, perinatal health status and health care utilization, pregnancy outcomes, and postpartum health status.

We analyzed data collected in 13 cities/counties (one city and five counties in Northern China, one city and six counties in Southern China). From 1997 to 2000, 196 738 women delivered

single live births in the 13 sites. There were 195 796 women included in the analysis after excluding 0.5% (942/196 738) of women with missing data on preconceptional care or timing of prenatal care initiation.

Definition of early and late initiation of prenatal care
Early initiation of prenatal care was defined as beginning prenatal care before 15 completed gestational weeks (equals to three completed months of gestation) and late initiation of prenatal care as beginning prenatal care after 15 completed gestational weeks or receiving no prenatal care at all.[14] Gestational age at prenatal care onset was determined by the interval in weeks between the first date of the last menstrual period and the date of the first prenatal care visit. The date of each woman's last menstrual period was derived from the health records in Perinatal Health Care Surveillance System.

Related variables to evaluate
Women were defined as having preconceptional health care utilization if they had physical examinations or counseling by health professionals before this pregnancy. Other variables that we evaluated included maternal residence (rural/urban areas), occupation (farmers/non-farmers), educational attainment (12 years or more, 9 to 11 years, less than 9 years), parity (nulliparous/multiparous), and age at delivery (20–24, 25–29, 30–34, and $\geqslant$35 years). No women were less than 20 years old at time of delivery in surveyed areas owing to the following reasons: (1) women are not permitted to marry and deliver by marriage law in China until they are at least 20 years old; (2) women usually deliver after their marriage in Chinese tradition. We did not divide women by their marital status because: (1) there was no variable on marital status in our database; (2) little childbirth was out of wedlock in surveyed areas owing to the same reasons mentioned above. We also evaluated the effects of the medical risk factors during the first trimester on the timing of prenatal care initiation. If one woman experienced bleeding in pregnancy, hyperemesis gravidarum or fever during the first trimester, which was diagnosed by doctors at township or above levels, she was defined as having a high-risk medical experience during the first trimester. Another variable we considered was whether the women had a preconceptional medical disorder, which might affect both preconceptional health care utilization and the initiation of prenatal care. We defined a woman as having a preconceptional medical disorder if she had chronic hypertension, diabetes, heart diseases, nephropathy, liver diseases, anemia, psychosis, hyperthyroidism, or tuberculosis before the present pregnancy.

Data entry and cleaning
Data in the health records were entered into computers by trained professionals at Maternal and Child Health Care Units in surveyed areas. The data were then uploaded or sent to Institute of Reproductive and Child Health, Peking University. The staff at Peking University finished checking, cleaning, and auditing the data. The data with incomplete entries and logistic errors would be referred back to the MCH units to recheck so as to ensure the completeness and accuracy.

Statistical methods
The χ^2 test was used to assess the difference in the distribution of selected characteristics by preconceptional care status and initiation of prenatal care. The Mantel–Haenszel test was employed to calculated risk ratios and 95% confidence intervals (CI) stratified by maternal residence, age at delivery, educational attainment, occupation, parity, preconceptional medical disorder, and high-risk medical experiences during the first trimester. Multivariate logistic regression was conducted to assess the association between preconceptional health care utilization and early initiation of prenatal care after controlling for the above-mentioned stratification factors and the interaction of maternal age, parity, and educational attainment. SPSS 11.5 (SPSS Inc.) was employed for data analysis.

Results

Among the 195 746 women (Supplementary Table 1), 81.3% lived in rural areas and 63.0% were farmers. Over 80% were in their twenties at delivery and 78.0% were nulliparous. Only 21.6% of the subjects had finished 12 years or more of formal education. Only 2.9% had preconceptional medical disorders. About 5% of the subjects had high-risk medical experiences during the first trimester of the present pregnancy. The proportion of women having preconceptional health care utilization was 64.2%. The average prevalence of early initiation of prenatal care was 88.5% (173 294/195 796).

Women who had preconceptional health care utilization differed by selected characteristics from women who did not have preconceptional health care utilization (Table 1). Women who had preconceptional health care utilization were more likely to live in rural areas, be aged 20 to 24 years and 25 to 29 years, have finished at least 9 years of formal education, be non-farmers, and be nulliparous.

Women who had early initiation of prenatal care differed by selected characteristics from women who began prenatal care late (Table 2). Women who had early onset of prenatal care were more likely to have had preconceptional health care utilization compared with women with late initiation of prenatal care (66.8 vs 43.9%). They also were more likely to live in rural areas, be aged 20 to 24 and 25 to 29 years, have at least 12 years of formal education, work as non-farmers, be nulliparous, and having high-risk medical experiences during the first trimester of present pregnancy.

Table 3 shows the association between preconceptinal health care utilization and early initiation of prenatal care after stratification by maternal characteristics. Women who had

Table 1 Distribution of preconceptional health care utilization by selected characteristics

Characteristics	*Preconceptional health care utilization*	
	Yes	*No*
*Residence**		
Urban areas	20.3	15.9
Rural areas	79.7	84.1
*Maternal age at delivery (year)**		
20–24	53.4	21.2
25–29	41.5	36.2
30–34	4.6	39.2
35 and more	0.5	3.3
Educational attainment,*[a]		
12 years and more	24.6	16.3
9–11 years	63.8	56.8
Less than 9 years	11.6	26.9
Occupation,*[b]		
Farmers	58.4	71.5
Non-farmers	41.6	28.5
Parity,*[c]		
Nulliparous	95.4	48.0
Multiparous	4.6	52.0
Having a high-risk medical experience during the first trimester,*[d]		
Yes	5.4	5.0
No	94.6	95.0
Having a preconceptional medical disorder,*[e]		
Yes	2.7	3.4
No	97.3	96.6

**P*<0.001.
[a]489 women with missing data on educational attainment were excluded.
[b]430 women with missing data on occupation were excluded.
[c]1 410 women with missing data on parity were excluded.
[d]2 329 women with missing data on high-risk medical experiences were excluded.
[e]413 women with missing data on preconceptional medical disorders were excluded.

preconceptional health care utilization were 2.6 (95%CI 2.5, 2.6) times more likely to have early initiation of prenatal care than were women who did not have preconceptional health care utilization. When stratified by a variety of maternal characteristics, this association still existed in all subjects. The association was greatest among women aged 20 to 24 years (RR: 4.0, 95%CI 3.8, 4.2).

Women having preconceptional health care utilization were 2.7 (95%CI 2.6, 2.8) times more likely to have early initiation of prenatal care than were women not having preconceptional health care utilization (Table 4) after controlling for maternal residence, age at delivery, educational attainment, occupation, parity,

Table 2 Distribution of initiation of prenatal care by selected characteristics

Characteristics	*Timely initiation of prenatal care*	*Late initiation of prenatal care*
*Preconceptional health care utilization**		
Yes	66.8	43.9
No	33.2	56.1
*Residence**		
Urban areas	42.2	41.5
Rural areas	57.8	58.5
*Maternal age at delivery (year)**		
20–24	42.0	40.0
25–29	39.9	37.2
30–34	16.7	20.5
35 and more	1.4	2.3
Educational attainment,*[a]		
12 years and more	22.5	14.3
9–11 years	61.3	61.8
Less than 9 years	16.1	23.9
Occupation,*[b]		
Farmers	62.0	72.5
Non-farmers	38.0	27.5
Parity,*[c]		
Nulliparous	79.2	72.3
Multiparous	20.8	27.7
Having a high-risk medical experience during the first trimester,*[d]		
Yes	5.4	4.3
No	94.6	95.7
Having a preconceptional medical disorder[e]		
Yes	2.9	3.0
No	97.1	97.0

**P*<0.001.
[a]489 women with missing data on educational attainment were excluded.
[b]430 women with missing data on occupation were excluded.
[c]1 410 women with missing data on parity were excluded.
[d]2 329 women with missing data on high-risk medical experiences were excluded.
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preconceptional medical disorders, high-risk medical experiences during the first trimester of the present pregnancy, and the interaction of maternal age, educational attainment, and parity.

Discussion

Our findings have shown that the women having preconceptional health care utilization are 2.6 times more likely to have early initiation of prenatal care than are women who did not have

Table 3 Association between preconceptional health care utilization and early initiation of prenatal care stratified by selected maternal characteristics

Characteristics	*Risk ratio*	*95%CI*
Overall RR	2.6	(2.5,2.6)
*Residence**		
Urban areas	1.7	(1.6,1.9)
Rural areas	2.7	(2.6,2.8)
*Maternal age at delivery (year)**		
20–24	4.0	(3.8,4.2)
25–29	2.6	(2.5,2.7)
30–34	1.3	(1.2,1.4)
35 and more	2.0	(1.5,2.6)
Educational attainment,*[a]		
12 years and more	2.1	(2.0,2.3)
9–11 years	2.8	(2.7,2.9)
Less than 9 years	1.8	(1.6,1.9)
Occupation,*[b]		
Farmers	2.6	(2.5,2.7)
Non-farmers	2.2	(2.1,2.3)
Parity,*[c]		
Nulliparous	2.9	(2.8,3.0)
Multiparous	1.2	(1.1,1.3)
Having a high-risk medical experience during the first trimester,*[d]		
Yes	2.2	(1.9,2.6)
No	2.4	(2.3,2.4)
Having a preconceptional medical disorder[e]		
Yes	2.6	(2.2,3.0)
No	2.6	(2.5,2.6)

*$P<0.001$.
[a]489 women with missing data on educational attainment were excluded.
[b]430 women with missing data on occupation were excluded.
[c]1 410 women with missing data on parity were excluded.
[d]2 329 women with missing data on high-risk medical experiences were excluded.
[e]413 women with missing data on preconceptional medical disorders were excluded.

Table 4 Some factors associated with early initiation of prenatal care

Variables	B	*P*	*RR*	*95% CI*
Preconceptional health care utilization				
Yes	0.983	0.000	2.7	(2.6,2.8)
No			1.0	
Residence				
Urban	0.133	0.000	1.2	(1.1,1.2)
Rural			1.0	
Maternal age at delivery (year)	0.000			
20–24	−0.185	0.003	0.8	(0.7,0.9)
25–29	0.122	0.028	1.1	(1.0,1.3)
30–34	0.330	0.000	1.4	(1.3,1.5)
35+			1.0	
Educational attainment	0.000			
12 years and more	0.091	0.204	1.1	(1.0,1.3)
9–11 years	0.190	0.000	1.2	(1.1,1.3)
Less than 9 years			1.0	
Occupation				
Farmers			1.0	
Non-farmers	0.151	0.000	1.2	(1.1,1.2)
Parity				
Nulliparous	−0.318	0.000	0.7	(0.7,0.8)
Multiparous			1.0	
Having a high-risk medical experience during the first trimester				
Yes	0.154	0.000	1.2	(1.1,1.3)
No			1.0	
Interaction of maternal age, educational attainment, and parity[a]				
Age1 × edu1 × parity1	0.706	0.000	2.0	(1.7, 2.4)
Age1 × edu2 × parity1	0.363	0.000	1.4	(1.3, 1.6)
Age2 × edu1 × parity1	0.490	0.000	1.6	(1.4, 1.9)
Age2 × edu2 × parity1	0.085	0.069	1.1	(1.0, 1.2)
Age3 × edu1 × parity1	0.070	0.549	1.1	(0.9, 1.3)
Age3 × edu2 × parity1	0.001	0.991	1.0	(0.9, 1.1)
Age4 × edu3 × parity2			1.0	
Constant	1.328	0.000	3.8	

[a]Age1: 20–24 years, age2: 25–29 years, age3: 30–34 years, age4:35 years or more; edu1: 12 years and more of formal education, edu2: 9–11 years of formal education, edu3: less than 9 years of formal education; parity1: nulliparous women, parity2: multiparous women.

preconceptional health care utilization. A significant association between preconceptional health care utilization and early initiation of prenatal care persists when examined both in stratified analyses among each of the maternal characteristics we utilized and in multivariate logistic regression models. Thus, it appears that preconceptional care may be one of several factors that influence the access to early prenatal care among pregnant women in our cohort. Our findings underscore the statement by Moos MK.[15] that preconceptional health promotion should be made available to all women. This work also suggests that preconceptional care as a logical precursor to prenatal care could be considered an opportunity to promote early access to prenatal care.

We have found that the greatest association of preconceptional health care utilization and early initiation of prenatal care exists among women aged 20 to 24 years. One possible explanation is that there are more nulliparous women among those aged 20 to 24 years than other age groups. In our cohort, the proportion of

nulliparous women among those aged 20 to 24 was 98.2% (80 087/81 567), 85.2% (65 482/76 843) among those aged 25 to 29 years, 19.6% (6492/33 076) among those aged 30 to 34, and 22.3% (649/2257) among those aged 35 years or more. Compared with multiparous women, nulliparous women usually have fewer experiences related to pregnancy and delivery and may be more likely to seek prepregnancy care, counseling, and then begin prenatal care in a timely fashion. When interacting maternal age, parity, and preconceptional health care utilization in a logistical regression model, we found that the nulliparous women who aged 20 to 24 years and had preconceptional health care utilization are 3.1 times (95%CI: 2.9 to 3.4) likely to have early initiation of prenatal care as compared with multiparous women who aged 35 years and more and did not have preconceptional health care utilization. This finding indicates that preconceptional care may promote early initiation of prenatal care more often among nulliparous women than multiparous ones.

This analysis is among the first to examine the association of early initiation of prenatal care and preconceptional health care utilization using a large-scale population-based data. The Perinatal Health Care System data set has undergone systematic audit and validity assessment before being used for analysis, which assures the validity and reliability of our results. However, there are still several limitations to our study. Firstly, the exclusion of 2208 pregnancy losses before 20 weeks may result in some selection bias, making our findings slightly away from the null in theory. Secondly, there may be a potential weakness in our study because we did not have information on all potential confounders (e.g. taking medicine, catch a cold) in our surveillance system when examining the association between preconceptional health care utilization and early initiation of prenatal care. Thirdly, because the women who received preconceptional care in a nonsurveyed district and delivered in the surveyed areas were classified into no-preconceptional health care utilization in our cohort, this might lead to an artificially higher number of women in the no-preconceptional health care utilization group. In addition, because there may be similar factors promoting access to both preconceptional care and early access to prenatal care, caution should be exercised when considering a causal relationship between preconceptional care and early initiation of prenatal care. Therefore, preconceptional care only can be considered one possible opportunity rather than the definite intervention to promote early access to prenatal care.

The significant association between preconceptional health care utilization and early initiation of prenatal care demonstrates the prepregnancy health care utilization as one opportunity to promote timely onset of prenatal care. Timely access to prenatal care permits women getting timely risk assessment, consulting, or preventive services so as to improve pregnancy outcomes. Therefore, prepregnancy health care should be made accessible to all women so as to get timely prenatal care and to avoid abnormal pregnancy outcomes.

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Supplementary Information accompanies the paper on the Journal of Perinatology website (http://www.nature.com/jp)