The second pregnancy has no effect in the incidence of macrosomia: A cross sectional survey in two western Chinese regions

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Research article

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Abstract

After the implementation of the universal two-child policy in 2015 in China, the increase in parity has led to an increase in adverse pregnancy outcomes. The impact of parity on the incidence of fetal macrosomia has not been fully confirmed in China.This study aimed to explore the differences in the incidence of fetal macrosomia between first and second pregnancies in Western China. A total of 1598 pregnant women from three hospitals were investigated by means of a cross-sectional study from August 2017 to January 2018. Participants were recruited by a convenience sampling method and divided into first and second pregnancy groups. These groups included 1094 primiparas and 504 women giving birth to their second child. Univariate and multivariate logistic regression analyses were performed to discuss the differences in the incidence of fetal macrosomia in first and second pregnancies. No significant difference was found in the incidence of macrosomia in the first pregnancy group (7.2%) and the second pregnancy group (7.1%). In the second-time pregnant mothers, no significant association was found between the macrosomia of the second child (5.5%) and that of the first child (4.7%). In conclusion: the incidence of macrosomia in Western China is not affected by second childbirth, that is not affected by low parity. History of first child macrosomia was not a predictor of second child macrosomia.

Background

Fetal macrosomia is a term used to define a newborn that is significantly larger than average, with a birth weight ≥ 4000 g or in the 90th percentile in terms of gestational age [1]. In recent years, the incidence of fetal macrosomia has increased globally [2,3,4]. Fetal macrosomia is suggested to be associated with increased risk of adverse outcomes in the mother and the infant [5]. Some previous studies showed that the most important neonatal complications of macrosomia are shoulder dystocia, perinatal asphyxia, birth injury, hypoglycemia, meconium aspiration syndrome, and death [5,6,7]. Additionally, fetal macrosomia is more likely to lead to obesity, hypertension, and type–2 diabetes mellitus in adulthood [8]. Fetal macrosomia increases the risk of postpartum hemorrhage, infection, cesarean delivery, prolonged labor, high-degree perineal tears, anesthetic accidents, and thromboembolism [9]. In 2013, the Chinese government introduced a policy that allows couples, at least one of which is an only child, to have two children; in October 2015, China implemented the universal two-child policy [10]. With a large number of families eager to have two births, the birth peak of two children has come under the influence of national policies, leading to an increase in parity and the consequent increase in pregnancy risks. With the improvement of the living standards of Chinese people, the incidence of fetal macrosomia increased from 6% in 1995 to 7.8% in 2005 [11,12]. Multiple surveys conducted in various regions of China showed an increase in the incidence of fetal macrosomia. For example, a survey conducted in Harbin, China showed that the incidence of fetal macrosomia increased from 8.31% in 2001 to 10.50% in 2005 [13]. Similarly survey data from Shanghai revealed a 50% increase in the incidence of fetal macrosomia from 1989 to 1999[14]. Survey data collected across 14 provinces in China showed an overall macrosomia incidence of 7.3%, ranging from 4.1%–13.4%[15].

The causes of fetal macrosomia are complex and mostly remain unexplained. Some risk factors have been identified, and these factors include high pre-pregnancy body mass index (BMI), excessive weight gain during pregnancy, prolonged gestation, male fetal sex, multiparity, maternal age, maternal height, pre-gestational diabetes, and gestational diabetes[16,17,18]. Among them, parity is one of the important factors affecting the occurrence of fetal macrosomia. Studies showed that the maternal peritoneal and uterine wall of multiparas is more relaxed than that of primiparas. Changes in the uterine cavity volume and the extension of the duration of pregnancy preservation after multiple pregnancies are likely to cause the fetus to be overweight and suffer from fetal macrosomia [16,19]. As the number of pregnancies increases, the weight of the fetus also increases, along with the risk of macrosomia [1,16,20,21,22]. The study by Akin Usta et al. showed a 64% multiparity rate among mothers with fetal macrosomia, as well as a significantly higher parity in the macrosomia group than in the control group[23]. However, related studies on the incidence of fetal macrosomia focused on high parity (more than four pregnancies). The impact of one and two fetuses on the incidence of fetal macrosomia has not been fully confirmed in China, especially after the implementation of the universal two-child policy. Therefore, the current research on fetal macrosomia is necessary. We aim to investigate parturients in the Western China cities of Lanzhou and Chongqing via a cross-sectional study to explore the differences in the incidence of fetal macrosomia in first and second pregnancies. It also provide reference for further study of the influencing factors of macrosomia and reduction of the incidence of macrosomia.

Methods

Study population and methods

This study is part of the social science planning project of Chongqing, China and includes data from the maternal investigation. This cross-sectional study was conducted from August 2017 to January 2018 in three hospitals (two from Chongqing and one from Lanzhou, Gansu). The subject mothers were surveyed two to three days after childbirth in the obstetrics and gynecology departments of each hospital. This study used convenience sampling method to naturally divide the subjects into the first and second parturient groups. In total, 1,598 pregnant women were included in the study, including 1,094 primiparas and 504 women giving birth to their second child. We also examined the participants of the second pregnancy group and further divided it into the fetal and non-fetal macrosomia groups to identify any potential relationships between macrosomia cases in the second child and those in the first child. The inclusion criteria for parturients were a gestational age of more than 37 gestational weeks and successful single births as first and second births. The exclusion criteria were maternal births with third parity and above; complications in pregnancy and childbirth history, such as therioma, pregnancy associated with cardiac disease, and gynecological diseases; and maternal delivery with congenital malformations. The criteria were implemented to exclude potential confounding and bias effects, such as prematurity and diseases in infants.

Questionnaire

Questionnaire design and content

The questionnaire was designed by the Public Nutrition and Health Research group, School of Public Health, Medical University of Chongqing. The questionnaire was self-filled and included the pre-investigation and formal investigation. It took about 15 minutes to finish the questionnaire. The questionnaire consisted of three parts, namely, demographic characteristics, status of health behavior, and pregnancy outcomes. The following sociodemographic factors were included in the questionnaire: ethnicity (Han/minority), only child (Yes/No), height and weight, area (Gansu/Chongqing), residence (town/rural), educational level (primary/intermediate/senior), marital status (married/unmarried/divorced or widowed), per capita income of the family (<4500¥/4500¥ to 9000¥/>9000¥), and family medical history (yes/no/don't know). The status of health behavior included the daily physical activity time (<30 mins/>30 mins). The pregnancy outcomes included parity (first /second pregnancy), gender of the newborn (male/female), maternal BMI(kg/m^2), neonatal weight, fetal macrosomia (yes/no), mode of delivery (normal childbirth/uterine-incision delivery), and pregnancy-related complications (placenta previa/uterine scarring/pregnancy-induced hypertension/cholestasis of pregnancy/premature rupture of membranes/hydramnion/hypamnion/fetal growth restriction/anemia/thrombocytopenia/pregnancy associated with cardiac disease/pregnancy combined with thyroid disease/pregnancy with viral hepatitis/AIDS/others/nothing) [24].

Statistical analyses

Frequencies and percentages values were recorded to describe the demographic characteristics of the first and second pregnancy groups and the second pregnancy group. The mean, standard deviation, Pearson's chi-square test, and t test described the differences in parity and the influential factors of macrosomia in the first and second parturient groups and in the second pregnancy group. Multivariable logistic regression analysis was used to assess the association between parity (first and second pregnancy) and macrosomia incidence after the adjustment of related variables. Based on the literature, we adjusted for the following covariates: maternal age (years, <30/≥30), maternal height (m), delivery weight (kg), maternal BMI (kg/m^2, <30/≥30), gestational diabetes mellitus (Yes/No), gestational hypertension (Yes/No), physical activity time (daily) (<30mins/≥30mins), and fetal gender (Male/Female) [16,17,18]. Statistical significance was considered at $p < 0.05$. Data analyses were carried out using the statistical software Statistical Package for Social Science version 22 (IBM; Armonk, New York, USA).

Results

Sample characteristics and macrosomia incidence

Table 1 shows the demographic characteristics and macrosomia incidence of the first and second pregnancy groups. These groups included 1094 (68.5%) primiparas and 504 (31.5%) women giving birth to their second child. There was no statistical significance in the incidence of fetal macrosomia in the

first (7.2%) and second (7.1%) pregnancy groups. The number of participants who are a single child is lower in the second pregnancy group (20.4%) than in the first pregnancy group (32.4%). The first pregnancy group (80.1%) reported higher education levels than the second pregnancy group (73.2%) did.

Univariate analysis of associated factors of macrosomia

Table 2 shows the differences in macrosomia-related indicators between the fetal macrosomia and non-fetal macrosomia groups. There was no significant difference in parity distribution between macrosomia group and non-macrosomia group. The fetal macrosomia group had a higher delivery weight (63.8kg vs 60.9kg), maternal BMI (24.4 kg/m^2 vs 23.5kg/m^2) than the non-fetal macrosomia group. But, the maternal age of the fetal macrosomia group was lower than the non-fetal macrosomia group (28.5 years vs 29.1 years).

Univariate analysis of second-time pregnant mothers

Table 3 shows the difference in first pregnant macrosomia incidence and macrosomia influence factors of the second-time pregnant mothers. Among the second pregnancy, there was no association between the history of first child macrosomia (4.7%) and the second child macrosomia (5.5%). Mothers gave birth to a non-fetal macrosomia child was older (28.9 years vs 27.8 years) and more physically active (19.7% vs 5.5%) than those gave birth to a fetal macrosomia child. The prevalence of self-reported gestational diabetes and hypertension was low.

Multivariate logistic regression analysis

After adjusting for potential confounding factors, parity (first and second pregnancies) was not associated with fetal macrosomia (Table 4). Mothers older than 30 years are less likely to give birth to infants with macrosomia (OR 0.6, 95% CI 0.4,0.9). Maternal obesity (OR 2.1, 95% CI 0.9,4.9) and gestational hypertension (OR 1.8, 95% CI 0.9,3.8) were marginally positively associated with macrosomia.

Discussion

In the study we found low parity was not associated with macrosomia in Western China. With the improvement of the living standards of Chinese people, the incidence of fetal macrosomia has increased [11,12,13,14,15]. It has been shown that multiple parities can lead to the relaxation of the peritoneum and uterine wall, an increase in uterine volume, and an extension of the duration of pregnancy preservation after multiple pregnancies, which leads to an increased risk of macrosomia [1,16,19,20,21,22]. We hypothesized that macrosomia incidence in second children will increase. However, the findings refuted our hypothesis. Furthermore, the birth of a second child with macrosomia was not significantly related to the occurrence of macrosomia in the first child. However, this finding is not without practical significance. Some studies have shown that increased parity is associated with a high risk of fetal macrosomia[21,22]. In a study from Sack, mothers with multiple pregnancies had a higher risk of having fetal macrosomia than those in the control group did [22]. Dor et al. reported that the multiparity rate was approximately

70% in the case group[21]. Similarly, the study of Akin Usta et al. showed a multiparity rate of 64% among mothers with fetal macrosomia and a significantly higher parity in the macrosomia group than in the control group [23]. Results from the aforementioned studies are based on mothers with more than two pregnancies. By contrast, the current study focused on only the first and second pregnancies. Therefore, potentially removing the effects of peritoneal and uterine walls and the uterine cavity volume of pregnant women on giving birth to a second child is possible. In the context of China's "two-child policy," we have strong evidence that suggests that Chinese mothers may not have to be concerned with the possibility of having a second child with macrosomia. In the Chinese context, the increase in the incidence of macrosomia may be mainly due to the increase of obesity and other chronic diseases. The prevention of fetal macrosomia should give priority to lifestyle intervention and prevention of obesity.

We found that among the second pregnancy, there was no association between the history of first child macrosomia and the second child macrosomia, history of first child macrosomia was not a predictor of second child macrosomia. This finding may indicate that for two pregnancies of the same woman, the birth of a second child with macrosomia is not related to whether the first child had macrosomia.

This study found that mothers older than 30 years are less likely to give birth to babies with macrosomia. The finding is inconsistent with studies in other countries. For example, it has been shown that mothers aged 30 years may be at risk for macrosomia in Tanzania [16]. A study conducted in the United Kingdom showed that the incidence of macrosomia in women between 35 and 39 years increased by 40% as compared to women under 35 years old[25]. Our research also showed that the compared with those in the second pregnancy group, the mothers in the first pregnancy group were older and received higher education. We speculate that this result may be due to the fact that relative to pregnant women under the age of 30, pregnant women over the age of 30 in China are more educated and have better cognition of maternal and child health care. Studies also showed that mothers with higher education have a lower risk of macrosomia than mothers without higher education have[26]. However, mothers in their second pregnancy may possibly have extensive knowledge or education about pregnancy-related health. Education has been recognized as the most important social factor affecting the health of mothers and children [27]. Health and perinatal-educated mothers can maintain a healthy lifestyle, which is important for avoiding poor perinatal outcomes [26]. Previous studies showed that the risk factors for perinatal outcomes such as macrosomia are clearly related to perinatal education [28,29]. Although the first pregnancy group reported higher education levels, the second pregnancy group had more perinatal experience, which may be the reason why no significant difference was found in the macrosomia incidence between the first and second pregnancy groups. In the context of China's universal two-child policy, we believe that community and health departments should strengthen perinatal health education, which potentially plays an important role in preventing macrosomia and other adverse pregnancy outcomes.

An inverse association between physical activity and macrosomia was consistent with current knowledge. The American College of Obstetricians and Gynecologists, the Royal College of Obstetricians and Gynaecologists, and the Royal College of Midwives collectively recommend 30 minutes of daily

moderate-intensity physical activity for low-risk pregnant women regardless of the stage of pregnancy[30,31,32]. Regular physical activity can lower the risk of gestational diabetes and thus reduce the macrosomia incidence [31,33,34]. However, among many Caucasian women with high education and income, there was a misperception that physical activities may be unsafe, exhausting, and uncomfortable, hence their inactivity[35,36]. It is unknown whether the same misperception exists among Chinese women as the prevalence of adequate physical activity.

Limitations of the study

The limitations of the study include the following. First, we chose only two regions of Western China to conduct surveys, and thus, our work cannot fully reflect the reality of China as a whole. Second, the prevalence of gestational diabetes and hypertension was lower than the literatures. Under-reporting of these conditions is likely. All these potential limitations should be considered when the results are interpreted.

Conclusions

The incidence of macrosomia in Western China is not affected by second childbirth, that is not affected by low parity. History of first child macrosomia was not a predictor of second child macrosomia.

Abbreviations

BMI□body mass index; SD: standard deviation; OR: odds ratio; CI: confidence interval; AIDS: Acquired Immune Deficiency Syndrome

Declarations

Funding

The current situation and influencing factors of two child reproductive behaviors among couples of childbearing ages under the " two-child policy “. Our research came from the part of the maternal investigation.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This research was performed in accordance with the Declaration of Helsinki and approved by the Ethical Committee of Chongqing Medical University (ethical approval code: 2016001). All participants were informed of the purpose of the study and their cooperation was voluntary, and they submitted signed Informed consent.

Consent for publication

Not applicable

Competing interests

The authors declare no conflict of interests.

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Tables

Table 1 Distribution of characteristics and macrosomia incidence among participants

Variables	Pregnant women in their first pregnancy (n, %)	Pregnant women in their second pregnancy (n, %)	p-Value
Ethnicity			0.398
Han	1020(93.2)	464(92.1)	
Minority	74(6.8)	40(7.9)	
Maternal age (years)	29.21±3.51	28.80±3.39	0.027*
Single-child			<0.0001****
Yes	354（32.4）	103（20.4）	
No	740（67.6）	401（79.6）	
Marital status			
Unmarried	9（0.8）	3（0.6）	
Married	1078（98.5）	498（98.8）	
Divorced or Widowhood	7（0.7）	3（0.6）	
Education level			0.004**
Low	116（10.6）	81（16.1）	
Medical	102（9.3）	54（10.7）	
High	876（80.1）	369（73.2）	
Location			0.443
Lanzhou	863（78.9）	389（77.2）	
Chongqing	231（21.1）	115（22.8）	
Residence			0.515
Urban	951（86.9）	444（88.1）	
Rural	143（13.1）	60（11.9）	
The per capita income of the family			0.066
< 4500¥	450（41.1）	208（41.2）	
4500¥ to 9000¥	506（46.3）	214（42.5）	
> 9000¥	133（12.6）	82（16.3）	
Fetal macrosomia			0.955
Yes	79（7.2）	36（7.1）	
No	1015（92.8）	468（92.9）	

* p < 0.05; ** p < 0.01; *** p < 0.001; **** p < 0.0001

Table 2 Univariate analysis of associated factors of macrosomia

Variables	Fetal macrosomia (n, %, Mean ± SD)	Non- fetal macrosomia (n, %, Mean ± SD)	p-Value
Parity			0.955
First pregnancy	79（68.7）	1015（68.4）	
Second pregnancy	36（31.3）	468（31.6）	
Maternal age (years)	28.46 2.86	29.13 3.52	0.020*
Maternal height(m)	1.62 0.05	1.61 0.05	0.214
Delivery weight(kg)	63.82 8.71	60.93 8.61	0.001**
Maternal BMI (kg/m^2)	24.41 3.36	23.45 3.16	0.002**
Gestational diabetes mellitus			0.835
Yes	5（4.3）	52（3.5）	
No	110（95.7）	1431（96.5）	
Gestational hypertension			0.075
Yes	9（7.8）	63（4.2）	
No	106（92.2）	1420（95.8）	
Physical activity time (daily)			0.101
< 30 mins	99（86.1）	1183（79.8）	
≥ 30 mins	16（13.9）	300（20.2）	
Fetal gender			0.775
Male	63（54.8）	792（53.4）	
Female	52（45.2）	691（46.6）	

*p < 0.05; ** p < 0.01; *** p < 0.001; **** p < 0.0001. SD, standard deviation. BMI, body mass index.

[a]Maternal BMI refers to the last weight recorded before delivery.

Table 3 Univariate analysis of factors that influence macrosomia in second-time pregnant mothers

Variables	The second child is fetal macrosomia (n, %, Mean ± SD)	The second child is Non- fetal macrosomia (n, %, Mean ± SD)	p-Value
The first child is fetal macrosomia			0.999
Yes	2(5.5)	22(4.7)	
No	34(94.5)	446 (95.3)	
Maternal age(years)	27.75 2.39	28.88 3.45	0.012*
Maternal height(m)	161.61 5.00	160.92	0.413
Delivery weight(kg)	63.92	61.99	0.184
Maternal BMI (kg/m^2)	24.47	23.94	0.315
Gestational diabetes mellitus			0.842
Yes	2□5.5□	16□3.4□	
No	34□94.5□	452□96.6□	
Gestational hypertension			0.999
Yes	2□5.5□	20□4.3□	
No	34□94.5□	448□95.7□	
Physical activity time (daily)			0.036*
< 30 mins	34□94.5□	376□80.3□	
≥ 30 mins	2□5.5□	92□19.7□	
Fetal gender			0.785
Male	20□55.6□	249□53.2□	
Female	16□44.4□	219□46.8□	

*p < 0.05; ** p < 0.01; *** p < 0.001; **** p < 0.0001. SD, standard deviation. BMI, body mass index.

[a]Maternal BMI refers to the last weight recorded before delivery.

Table 4 Bivariate logistic regression analysis of factors that affect delivery of fetal macrosomia

Variables		B	χ^2	p-Value	OR (95%CI)
Parity					
Pregnant women in their first pregnancy	1094(68.5)				1
Pregnant women in their second pregnancy		-0.048	0.053	0.818	0.9(0.6,1.4)
	504(31.5)				
Maternal age					
<30	939(58.8)				1
≥30	659(41.2)	-0.515	5.963	0.015*	0.6(0.4,0.9)
Maternal height					
<1.60	495(31.0)				
≥1.60	1103(69.0)				
Maternal BMI					
<30	1547(96.8)				1
≥30	51(3.2)	0.747	3.029	0.082	2.1(0.9,4.9)
Gestational diabetes mellitus					
Yes	57(3.6)	0.180	0.138	0.710	1.2(0.5,3.1)
No	1541(96.4)				1
Gestational hypertension					
Yes	72(4.5)	0.582	2.376	0.123	1.8(0.9,3.8)
No	1526(95.5)				1
Physical activity time (daily)					
< 30 mins	1282(80.2)	0.449	2.585	0.108	1.6(0.9,2.7)
≥ 30 mins	316(19.8)				1
Fetal gender					
Male	855(53.5)				1
Female	743(46.5)	-0.028	0.020	0.888	1.0(0.7,1.4)

*p < 0.05; ** p < 0.01; *** p < 0.001; **** p < 0.0001. BMI, body mass index. OR, odds ratio; CI, confidence interval.

[a]Maternal BMI refers to the last weight recorded before delivery.