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Impact of pre-pregnancy weight on the risk of premature rupture of membranes in Chinese women

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ABSTRACT

Objective: The objective of this study was to investigate the influence of pre-pregnancy body mass index (BMI) on the incidence of premature rupture of membranes (PROM) among Chinese women.

Methods: This was a hospital-based retrospective cohort study of 75,760 Chinese women who had live singleton births between 2016 and 2020. In this study, we utilized logistic regression analysis to estimate the association between pre-pregnancy BMI and PROM based on gestational age.

Results: Prior to pregnancy, being overweight or obese was found to be significantly associated with an increased risk of preterm premature rupture of membranes (PPROM), as evidenced by adjusted odds ratios and 95 % confidence intervals of 1.336 (1.173–1.522) and 1.411 (1.064–1.872), respectively. Those with PPROM were divided into three groups according to gestational age: 22–27, 28–31, and 32–36 weeks. Women who were overweight or obese prior to pregnancy had a higher likelihood of experiencing PROM between 22 and 27 weeks of gestation. This finding remained consistent even after controlling for potential confounding factors, such as gestational diabetes mellitus (GDM), gestational hypertension, preeclampsia, hydramnios, cervical abnormalities, and a history of preterm birth.

Conclusion: Our research findings indicate that being overweight or obese before pregnancy is linked to a higher likelihood of experiencing PPROM. Therefore, achieving optimal weight before pregnancy is important to prevent PPROM and its associated complications.

1. Introduction

Premature rupture of membranes (PROM) refers to the rupture of fetal membranes prior to the onset of labor and can be classified as either term PROM or preterm PROM (PPROM) based on the gestational age. In the United States, PPROM has been reported to occur in approximately 3 % of pregnancies [1]; in China, the incidence of PPROM is approximately 2.7 % [2]. PPROM causes adverse maternal and neonatal outcomes. Prematurity and its associated complications are the most significant neonatal complications. Prematurity is often associated with respiratory distress, patent ductus arteriosus, ventricular hemorrhage, necrotizing colitis, and sepsis, which are common complications [3]. Maternal complications of PROM include intra-amniotic infection, endometritis,

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placental abruption, and placental retention [4]. Considering the significant mortality and morbidity rates among extremely premature infants, as well as the potential maternal complications, it is imperative to gain a deeper understanding of PROM and its associated risk factors. The risk factors for PROM include age, low education level, vaginal bleeding during pregnancy, number of pregnancies, history of premature delivery, gestational diabetes, and smoking [5–7].

Obesity in women of childbearing age is common worldwide. Pregnant women who are overweight or obese before pregnancy have a higher risk of complications, such as gestational diabetes mellitus (GDM) and gestational hypertension [8–10]. Both domestic and international studies have demonstrated that pre-pregnancy overweight or obesity can lead to premature birth [11–13]. PPROM is responsible for up to 25–30 % of all preterm births [14], yet, there are limited data evaluating the relationship between obesity and PPROM [15]. In 2013, Cnattingius S et al. found that women with grade 2 and grade 3 obesity had an increased risk of PPROM compared to women with a normal body mass index (BMI) [16]. This study was conducted abroad and focused on the relationship between BMI and PPROM. However, there are differences in BMI classifications between foreign populations and Asian populations. Considering the limited research on the relationship between pre-pregnancy BMI and PROM in China, and the lack of a unified conclusion [17,18], it is necessary to study the relationship between pre-pregnancy BMI and PROM in Chinese pregnant women. Therefore, we aimed to study the relationship between maternal BMI before pregnancy and the occurrence of PROM.

2. Materials and methods

This retrospective cohort study involved women with singleton pregnancies who delivered at Shanghai First Maternal and Infant Hospital. Approximately one-third of annual deliveries in Shanghai occur at this hospital. We analyzed birth data between 2016 and 2020 to investigate the association between pre-pregnancy BMI and PROM at different gestational weeks. The definition of prematurity varies among different countries. In China, premature birth is defined as delivery occurring between 28 and 37 weeks of gestation [19]. We have reviewed fundamental information, encompassing maternal age, gestational age, delivery time, delivery mode, and history of preterm birth.

2.1. Study population

This study retrospectively selected all pregnant women who gave birth to singleton infants between 2016 and 2020 from the electronic medical record system of Shanghai First Maternal and Infant Hospital. Those with live births between 22 and 42 weeks of gestation were included. Women who met the following criteria were excluded: twin and multiple pregnancies (n = 2580), foreigner (n = 29), pre-pregnancy weight less than 35 Kg (n = 12), height less than 140 cm (n = 1), missing data (n = 1784), and pre-pregnancy hypertension or pre-pregnancy diabetes (n = 425). In total, 75,760 women were enrolled in the study (Fig. 1). Missing data in this study refers to the absence of one or more of the following indicators, including pre-pregnancy weight, height, maternal age, gestational age at delivery, history of preterm birth, parity, mode of delivery, hydramnios, cervical abnormalities, gestational diabetes mellitus, gestational hypertension, preeclampsia, premature rupture of membranes, and pre-delivery weight.

2.2. Exposure

The primary explanatory variable in this study was the maternal pre-pregnancy BMI, which is defined as the weight of the mother

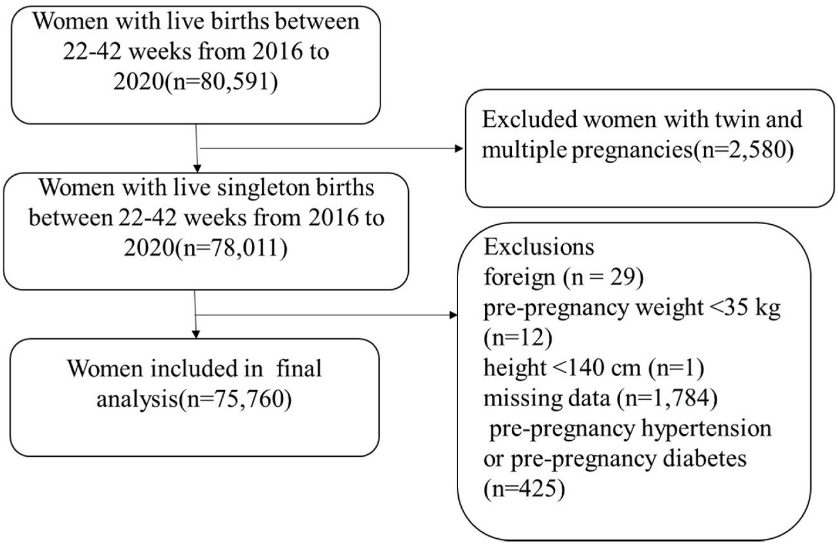

Fig. 1. Flow chart of the participant recruitment process.

before pregnancy divided by the square of her self-reported height (Kg/m^2). Based on the latest Asian women standards [20], the pregnant women in this study were categorized as underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5–22.9 kg/m^2), overweight (BMI 23–27.4 kg/m^2), or obese (BMI ≥27.5 kg/m^2).

2.3. Outcomes

The primary outcome was PROM. In this study, the diagnostic methods of PROM included vaginal outflow of amniotic fluid, alkalinity of vaginal fluid by PH test and fern-like crystals under microscope. Gestational age was determined using the reported date of the last menstrual period obtained during the initial prenatal examination. In cases where the fetal size measured by ultrasound significantly deviated from the gestational age estimated by the last menstrual period, the gestational age was instead determined based on the earliest ultrasound scan available. In this study, PPROM was defined as the rupture of membranes between 22 and 36 weeks of gestation [21]. Term PROM is defined as the rupture of the membranes at or after 37 weeks of gestation. In the main analysis, we divided women with PROM into two groups: those with term PROM and those with PPROM. The PPROM group was further classified according to gestational age (22–27 weeks, 28–31 weeks, and 32–36 weeks).

2.4. Statistical analysis

The continuous variable data were presented as the mean ± standard deviation (X ± S). The chi-square test was utilized to represent the percentage of data count (%). A P value less than 0.05 was deemed statistically significant. A logistic regression model was employed to calculate odds ratios (ORs) and 95 % confidence intervals (CIs) for pre-pregnancy BMI, PROM, and their respective subgroups. Possible confounders included maternal age, delivery duration, and mode of delivery. We screened for gestational complications that may influence the results, including gestational diabetes, gestational hypertension, preeclampsia, hydramnios, cervical abnormalities, and a history of preterm birth. This was done to ensure the reliability and validity of the study. Cervical abnormalities included previous cervical surgery, such as conization of the cervix, cervical ligation, cervical human papillomavirus infection, and cervical intraepithelial lesions. Given that maternal age and the rate of gestational weight gain (GWG) are potential confounding factors between maternal obesity and PROM, we conducted a stratified analysis based on these factors. We categorize the maternal age into four groups: ≤24, 25–29, 30–34, and ≥35. Due to the different gestational weeks of pregnant women, it is more precise to utilize the rate of GWG instead of GWG alone. The rate of GWG can be computed by deducting the pre-pregnancy weight from the pre-delivery weight and subsequently dividing the result by the number of gestational weeks. Women without data on pre-pregnancy weight were excluded, and data of the remaining 53,234 were used for calculating the GWG rate. We divided GWG rates into three groups based on quartiles (insufficient: <25th percentile, P25; optimal: 25th to 75th percentile, P25–P75; and excessive, >75th percentile, >P75), as

Table 1
Basic characteristics of the study population by pre-pregnancy body mass index.

	Underweight	Optimal weight	Overweight	Obese	P value
Age group, y, n (%)					
≤24	743 (6.54)	1832 (3.80)	425 (3.03)	81 (3.73)	<0.05
25–29	5766 (50.77)	19551 (40.58)	4668 (33.23)	703 (32.34)	
30–34	3977 (35.01)	19969 (41.45)	6064 (43.17)	986 (45.35)	
≥35	872 (7.68)	6828 (14.17)	2891 (20.58)	404 (18.58)	
Gestational length, day	274.8 ± 9.5	274.8 ± 9.9	274.0 ± 11.1	269.6 ± 16.1	<0.05
History of preterm, n (%)					
Yes	66 (0.58)	287 (0.59)	119 (0.85)	17 (0.78)	<0.05
No	11292 (99.42)	47893(99.41)	13929 (99.15)	2157 (99.22)	
Parity status, n (%)					
Nulliparous	9394 (82.71)	36450 (75.66)	9729 (69.26)	1541 (70.88)	<0.05
Multiparous	1964 (17.29)	11730 (24.34)	4319 (30.74)	633 (29.12)	
Mode of delivery, n (%)					
Vaginal delivery	8556 (75.33)	33290 (69.10)	8121 (57.81)	1083 (49.82)	<0.05
Caesarean section	2802 (24.67)	14890 (30.90)	5927 (42.19)	1091 (50.18)	
Hydramnios, n (%)					
Yes	83 (0.73)	354 (0.73)	114 (0.81)	18 (0.83)	>0.05
No	11275 (99.27)	47826 (99.27)	13934 (99.19)	2156 (99.17)	
Abnormal cervix, n (%)					
Yes	239 (2.10)	894 (1.86)	256 (1.82)	57 (2.62)	<0.05
No	11119 (97.90)	47286 (98.14)	13792 (98.18)	2117 (97.38)	
Gestational diabetes mellitus, n (%)					
Yes	739 (6.51)	4774 (9.91)	2546 (18.12)	589 (27.09)	<0.05
No	10619 (93.49)	43406 (90.09)	11502 (81.88)	1585 (72.91)	
Gestational hypertension or preeclampsia, n (%)					
Yes	256 (2.25)	1719 (3.57)	1101 (7.84)	341 (15.69)	<0.05
No	11102 (97.75)	46461 (96.43)	12947 (92.16)	1833 (84.31)	

*Unless specified, the data represented are count and percentile (in the bracket).
BMI, body mass index.

there is no unified GWG classification in China. We conducted a stratified analysis of maternal age and rate of GWG to explore the confounding effects of maternal age and rate of GWG on pre-pregnancy BMI and PPROM, as maternal age and rate of GWG may be potential confounding factors. The data analysis was conducted using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp, Armonk, NY).

3. Results

In total, 75,760 pregnant women were included in the study over a period of six years, of whom 14,698 (19.40 %) had PROM (term PROM: 13,292 [17.54 %], PPROM: 1406 [1.86 %]). A total of 11,358 (14.99 %) women were underweight, 48,180 (63.59 %) had a normal weight, 14,048 (18.54 %) were overweight, and 2174 (2.87 %) were obese. Regarding age at delivery, 3081 (4.07 %) women were aged <24 years, 30,688 (40.51 %) were aged 25–29 years, 30,996 (40.91 %) were aged 30–34 years, and 10,995 (14.51 %) were aged ≥35 years. Compared with women who had a normal pre-pregnancy BMI (24.34 %), those who were overweight (30.74 %) or obese (29.12 %) were more likely to be multiparas. Furthermore, a higher proportion of women who were classified as overweight (42.19 %) or obese (50.18 %) underwent cesarean sections. In addition, women who were overweight or obese before pregnancy were more likely to develop GDM and hypertensive disorders than women with a normal pre-pregnancy BMI. The basic characteristics of the study population are shown in Table 1. We also classified pregnant women according to PROM status and PROM category (term/preterm). Our study revealed that pregnant women who are 35 years of age or older have a higher likelihood of experiencing PPROM. Moreover, most pregnant women with PROM were nulliparous and gave birth vaginally. Detailed data are shown in Supplementary Table 1.

Being overweight or obese before pregnancy was not related to the overall incidence of PROM or term PROM, but women who were overweight (adjusted OR: 1.34, 95 % CI: 1.173–1.522) or obese (adjusted OR: 1.41, 95 % CI: 1.064–1.872) were found to be at an elevated risk of experiencing PPROM. After classifying women with PPROM into three subgroups based on gestational age, we observed that women who were overweight or obese before pregnancy were more likely to experience PROM between 22 and 27 weeks of gestation (Table 2).

To evaluate the strength of the results, we performed another analysis after controlling for the following potential confounding factors: GDM, gestational hypertension, preeclampsia, hydramnios, cervical abnormality, and history of premature birth. The final results showed that women who were overweight (adjusted OR: 1.25, 95 % CI: 1.070–1.458) or obese (adjusted OR: 1.60, 95 % CI: 1.124–2.263) had a higher risk of experiencing PPROM. In the subgroup analysis according to gestational age, it was found that women who were overweight or obese prior to pregnancy had a higher likelihood of experiencing PROM at 22–27 weeks of gestation, and the conclusions were similar to those of the main analysis (Table 3).

Upon stratification by maternal age, it was observed that women who were overweight or obese prior to pregnancy exhibited a higher likelihood of experiencing PROM across all age groups. The group with age ≤24 years old included only 425 women who were overweight and 81 women who were obese, of whom three and four developed PPROM, respectively. When we stratified according to the rate of GWG, there was no significant correlation observed between pre-pregnancy BMI and PPROM (Table 4).

4. Discussion

This study evaluated the association of pre-pregnancy weight and PROM in a cohort study of more than 70,000 cases in Shanghai,

Table 2
Associations between pre-pregnancy body mass index (BMI) and premature rupture of membranes (PROM) at different gestational ages.

	Underweight		Optimal weight		Overweight		Obese	
	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)
Total PROM	2187 (19.26)	0.92 (0.870–0.966)	9607 (19.94)	1 (Ref)	2555 (18.19)	0.96 (0.916–1.010)	349 (16.05)	0.86 (0.760–0.962)
Term PROM	2001 (17.62)	0.91 (0.861–0.960)	8768 (18.20)	1 (Ref)	2227 (15.85)	0.92 (0.874–0.969)	296 (13.62)	0.79 (0.694–0.893)
Preterm PROM	186 (1.64)	0.98 (0.829–1.145)	839 (1.74)	1 (Ref)	328 (2.33)	1.34 (1.173–1.522)	53 (2.44)	1.41 (1.064–1.872)
PROM at 22–27 weeks of gestation	3 (0.03)	1.33 (0.357–4.961)	9 (0.02)	1 (Ref)	9 (0.06)	3.36 (1.320–8.574)	2 (0.09)	4.83 (1.017–22.943)
PROM at 28–31 weeks of gestation	6 (0.05)	0.48 (0.206–1.114)	59 (0.12)	1 (Ref)	20 (0.14)	1.05 (0.628–1.748)	3 (0.14)	1.01 (0.316–3.253)
PROM at 32–36 weeks of gestation	177 (1.56)	1.01 (0.852–1.188)	771 (1.60)	1 (Ref)	299 (2.13)	1.33 (1.165–1.529)	48 (2.21)	1.40 (1.042–1.884)

n (%) represents the number (rate) of PROM at different gestational weeks after BMI classification.
Ref, reference group; PROM, premature rupture of membranes; BMI, body mass index.
[a] Adjusted for maternal age, parity (nulliparous, multiparous), and mode of delivery (vaginal delivery, caesarean section).

Table 3
Associations between pre-pregnancy body mass index (BMI) and premature rupture of membranes (PROM) at different gestational ages after removing possible confounding factors.

	Underweight		Optimal weight		Overweight		Obese	
	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)
Total PROM	1986 (19.79)	0.91 (0.857–0.957)	8416 (20.74)	1 (Ref)	2006 (19.60)	1.00 (0.950–1.061)	242 (19.03)	1.00 (0.870–1.159)
Term PROM	1825 (18.19)	0.90 (0.849–0.951)	7723 (19.03)	1 (Ref)	1787 (17.46)	0.98 (0.923–1.035)	208 (16.35)	0.92 (0.794–1.076)
Preterm PROM	161 (1.60)	0.97 (0.818–1.160)	693 (1.71)	1 (Ref)	219 (2.14)	1.25 (1.070–1.458)	34 (2.67)	1.60 (1.124–2.263)
PROM at 22–27 weeks of gestation	2 (0.02)	1.15 (0.237–5.593)	7 (0.02)	1 (Ref)	6 (0.06)	3.28 (1.088–9.874)	2 (0.16)	9.22 (1.856–45.822)
PROM at 28–31 weeks of gestation	6 (0.06)	0.53 (0.225–1.229)	52 (0.13)	1 (Ref)	10 (0.10)	0.69 (0.348–1.358)	2 (0.16)	1.11 (0.269–4.572)
PROM at 32–36 weeks of gestation	153 (1.52)	1.01 (0.841–1.204)	634 (1.56)	1 (Ref)	203 (1.98)	1.28 (1.086–1.498)	30 (2.36)	1.55 (1.068–2.246)

n (%) represents the number (rate) of PROM at different gestational weeks after BMI classification.
Ref, reference; PROM, premature rupture of membranes; BMI, body mass index.
[a] Adjusted for maternal age, parity (nulliparous, multiparous), and mode of delivery (vaginal delivery, caesarean section).

Table 4
Associations between pre-pregnancy body mass index (BMI) and preterm premature rupture of membranes (PPROM) by maternal age and rate of gestational weight gain (GWG).

	Underweight		Optimal weight		Overweight		Obese	
	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)	n (%)	Adjusted[a] OR (95 % CI)
Maternal age, y								
≤24	15 (0.13)	1.82 (0.825–4.004)	19 (0.04)	1 (Ref)	3 (0.02)	0.56 (0.154–2.035)	4 (0.18)	4.17 (1.271–13.684)
25–29	70 (0.62)	0.75 (0.574–0.966)	318 (0.66)	1 (Ref)	101 (0.72)	1.35 (1.078–1.699)	16 (0.74)	1.39 (0.833–2.312)
30–34	81 (0.71)	1.13 (0.884–1.439)	360 (0.75)	1 (Ref)	142 (1.01)	1.33 (1.093–1.622)	21 (0.97)	1.20 (0.766–1.872)
≥35	20 (0.18)	1.10 (0.682–1.763)	142 (0.29)	1 (Ref)	82 (0.58)	1.43 (1.081–1.879)	12 (0.55)	1.59 (0.872–2.901)
Rate of GWG								
Inadequate (<P25)	32 (0.42)	1.32 (0.890–1.958)	131 (0.39)	1 (Ref)	75 (0.72)	1.25 (0.938–1.675)	17 (1.02)	1.21 (0.721–2.025)
Optimal (P25–P75)	45 (0.60)	0.77 (0.556–1.059)	249 (0.74)	1 (Ref)	97 (0.93)	1.47 (1.154–1.862)	9 (0.54)	1.10 (0.562–2.155)
Excessive (>P75)	29 (0.38)	1.22 (0.802–1.841)	110 (0.33)	1 (Ref)	32 (0.31)	1.09 (0.734–1.632)	4 (0.24)	1.28 (0.464–3.507)

n (%) represents the number (rate) of PPROM in different gestational weeks after BMI classification.
Ref, reference; PROM, premature rupture of membranes; BMI, body mass index; GWG, gestational weight gain.
[a] Adjusted for parity (nulliparous, multiparous) and mode of delivery (vaginal delivery, caesarean section).

China. Women who were overweight and obese accounted for 18.54 % and 2.87 % of the study population, respectively. Our findings indicated that pre-pregnancy overweight and obesity are significantly associated with PPROM, with a higher risk at 22–27 weeks of gestation.

Only a few studies have evaluated the association between pre-pregnancy BMI and the risk of PROM, and the conclusions are inconsistent [17,18]. Our findings are in line with previous study indicating that being overweight or obese before pregnancy raises the likelihood of PPROM [15]. A cohort study in the United States found that grade 1 to grade 3 obesity (BMI $\geq$30.0 kg/m^2) increased the risk of spontaneous premature birth at 20–23 weeks and 24–27 weeks of gestation [22]. Our study also revealed that women who were overweight or obese prior to pregnancy had a higher likelihood of experiencing PROM at 22–27 gestational weeks. A study published in JAMA in 2013 also showed that, women with a BMI $\geq$35 kg/m^2 have a higher risk of premature birth compared to those with a normal BMI at 22–27 gestational weeks due to PROM and preterm labor with intact membranes [16], which is consistent with our findings. Research has shown that, among women without chronic diseases, maternal obesity increased the risk of spontaneous premature delivery (including PROM and preterm labor with intact membranes) and extremely premature delivery at 23–27 gestational weeks [23]. In our study, after excluding cases of GDM, gestational hypertension, preeclampsia, hydramnios, cervical abnormalities, and a history of premature birth, we found that pre-pregnancy overweight and obesity still increased the risk of PPROM, especially at 22–27 gestational weeks. A cross-sectional study from Northern Ethiopia in 2020 showed that advanced maternal age was associated with premature birth but not with PROM [24]. A study conducted in China in 2017 found that advanced maternal age was related to GDM, hypertension, and a high risk of PROM [25]. Our study revealed that women, regardless of age, who were overweight or obese prior to pregnancy, had a higher likelihood of experiencing PPROM but not PROM.

The mechanism responsible for the correlation between pre-pregnancy overweight and obesity and PPROM remains unclear. Many factors cause the rupture of membranes. While term rupture of membranes may be due to normal physiological weakening of membranes and uterine contractility, PROM can be caused by various pathological mechanisms [26]. PPROM may be caused by infectious or non-infectious factors leading to premature destruction of immune homeostasis and an excessive inflammatory host reaction [27]. Histological chorioamnionitis and neutrophil infiltration into the membranes are all related to PPROM [28]. Compared with premature delivery with intact membranes, PPROM is characterized by higher levels of oxidative stress, protein peroxidation, lipid peroxidation, and DNA damage [29]. Systemic inflammation and local infection have been proposed to explain the increased risk of PPROM in obese women. Research has demonstrated that maternal obesity is associated with elevated systemic inflammation and heightened levels of related inflammatory markers, including C-reactive protein, monocyte chemoattractant protein-1, and interleukin-6 [30]. Obese women are also prone to genitourinary tract infections, which have been implicated in the pathogenesis of PROM [14]. Differences in the vaginal microbiome between obese women and women with a normal weight have also been suggested to cause PROM. The predominance of *Lactobacillus* in the vagina reflects healthy microbial colonization, as it exerts its protective role by creating an acidic environment and producing bioactive compounds [31]. A study of vaginal microbes in pregnant women in South Korea showed that women with PROM had greater concentrations and diversity of vaginal bacteria when admitted to the hospital than women with intact membranes. Moreover, *Lactobacillus* dominance differs between women with term and premature birth, suggesting a potential relationship between vaginal microorganisms and PPROM [32]. Another South Korean study showed that abnormal vaginal flora detected in the second trimester of pregnancy was associated with premature delivery before 28 weeks [33]. Therefore, we speculate that there is a certain correlation between PROM and vaginal microbiota, which opens up new avenues for our future research on the relationship between vaginal microbiota of pregnant women with different BMI and the risk of PROM.

The strengths of our study include its large scale and representativeness. Secondly, our study results may influence clinical practice, such as recommending weight modification before conception. In addition, there are few studies on pre-pregnancy BMI and PPROM; therefore, the results of this study are very informative. Because the obesity standards differ between Asian and Western populations, the BMI used in this study is tailored to the Asian population. However, according to published literature from abroad, our research findings are consistent with a large-scale study conducted in Sweden, even though they used a different BMI standard than our study [16]. Therefore, we believe that different BMI standards should be used for different racial populations. In order to validate the external validity of the conclusion that overweight and obesity increase the risk of PPROM, this association should be evaluated in other populations. This study is subject to certain limitations. Firstly, it is a retrospective study and the data on maternal height and pre-pregnancy weight were self-reported, which may have resulted in a slight bias in the relationship between BMI and the risk of PROM. Moreover, inaccurate BMI may have increased the possibility of many other pregnancy complications, which may have also affected the risk of PROM occurrence. In addition, in the classification of PPROM, the number of women in the BMI $\leq$24 kg/m^2 group was small, which may have affected the accuracy of the results. Finally, owing to the relatively limited correction factors of retrospective research, our study still has certain residual confounding. Our findings indicate that pre-existing overweight or obesity before pregnancy is strongly associated with an increased risk of PPROM. These results have practical clinical implications and suggest that optimizing pre-pregnancy weight is necessary to reduce the risk of PPROM and improve maternal and neonatal outcomes.

5. Conclusion

In conclusion, our findings indicate that pre-pregnancy overweight or obesity is linked to a heightened risk of PPROM. Therefore, achieving optimal weight before pregnancy is important to prevent PPROM and its associated complications.

Ethics statement

This study was approved by the Ethics Committee of the Shanghai First Maternal and Infant Hospital, affiliated with Tongji University School of Medicine (KS1998). Written informed consent for participation was not required for this study per national legislation and the institution's requirements.

Data availability statement

Data will be made available on request.

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CRediT authorship contribution statement

Hanxiang Sun: Conceptualization, Formal analysis, Writing – original draft. **Xiujuan Su:** Methodology. **Jing Mao:** Project administration, Supervision. **Qiaoling Du:** Funding acquisition, Writing – review & editing.

Declaration of competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e21971.

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