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Racial and Ethnic Disparities in Stillbirth among Pregnant Women with Obesity

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Abstract

Objective The aim of this study was to examine the relationship between obesity and risk of stillbirth among pregnant women with obesity in the United States, with a focus on racial and ethnic disparities.

Study Design We conducted a retrospective cross-sectional analysis of birth and fetal data from the 2014 to 2019 National Vital Statistics System ($N = 14{,}938{,}384$ total births) to examine associations between maternal body mass index (BMI) and risk of stillbirth. Cox's proportional hazards regression model was used to compute adjusted hazard ratios (HR) as a measure of risk of stillbirth in relation to maternal BMI.

Results The stillbirth rate was 6.70 per 1,000 births among women with prepregnancy obesity, while the stillbirth rate among women with a normal (nonobese) prepregnancy BMI was 3.85 per 1,000 births. The risk of stillbirth was greater among women with obesity compared with women without obesity (HR: 1.39; 95% confidence interval [CI]: 1.37–1.41). Compared with non-Hispanic (NH) Whites, women identifying as NH-other (HR: 1.66; 95% CI: 1.61–1.72) and NH-Black (HR: 1.31; 95% CI: 1.26–1.35) were at higher risk of stillbirth, while Hispanic women had a decreased likelihood of stillbirth (HR: 0.38; 95% CI: 0.37–0.40).

Conclusion Obesity is a modifiable risk factor for stillbirth. Public health awareness campaigns and strategies targeting weight management in women of reproductive age and racial/ethnic populations at highest risk for stillbirth, are needed.

Keywords
- stillbirth
- fetal death
- obesity
- racial disparities

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Key Points

- Stillbirth rates differ by race and ethnicity.
- Risk of stillbirth was greatest among women with obesity.
- Stillbirth rates rise with ascending prepregnancy BMI.

Obesity is a common chronic health condition with an increasing prevalence among youth and adults in the United States. Worldwide and in the United States, obesity is associated with several adverse health outcomes, many of which are among the leading causes of preventable, premature death, including heart disease, stroke, type 2 diabetes, and certain cancers.[1]

Among adults in the United States, there are noted disparities by age, biological sex, race, ethnicity, and socioeconomic status (SES), in both the prevalence and implications of excess weight and obesity. More specifically, recent national data suggest that compared with other racial/ethnic groups, non-Hispanic Blacks (NH-Blacks) had the highest prevalence of obesity, overall and among women.[2] Additionally, obesity is of particular concern among women during the childbearing years and pregnancy due to the increased risk of infertility and associated pregnancy-specific complications, including gestational diabetes mellitus, prepregnancy hypertension, gestational hypertension, venous thromboembolism, and preeclampsia.[3–6]

Maternal obesity has also been shown to be associated with adverse pregnancy outcomes, including an increased risk of stillbirth.[7–9] Defined as the loss of a fetus at ≥20 weeks of gestation, in the United States stillbirth occurs among 1 in 160 deliveries, with approximately 24,000 stillbirths reported annually.[10] Other risk factors for stillbirth include NH-Black race, advanced maternal age,[8,9] maternal history of hypertension, diabetes mellitus, pregnancy complicated by placental abnormalities (e.g., placental abruption), maternal infections, poor fetal growth, as well as complications during delivery like birth asphyxia.[11,12] Further, based on national fetal death data from 2017, there was considerable variation in stillbirth rates by race/ethnicity with the rate of stillbirth for NH-Black women (10.32 per 1,000 live births and stillbirths) being more than double the rate of NH-White women (4.89 per 1,000 live births and stillbirths).[13]

The gravity of the effects of race/ethnicity on pregnancy outcomes, combined with the interrelationship between obesity and race/ethnicity on stillbirth, is a timely topic not fully addressed in the current literature. Accordingly, considering the upsurge of obesity in the United States, the aim of this study was to examine the relationship between obesity and risk of stillbirth among pregnant women with obesity in the United States, with a focus on racial and ethnic disparities, using a large, nationally representative dataset that has sufficient power to yield valid results.

Materials and Methods

We used the 2014 to 2019 Birth Data and Fetal Death data obtained from the National Vital Statistics System (NVSS),[14] made publicly available by the Centers for Disease Control and Prevention (CDC), to conduct this retrospective cross-sectional multiyear study. The National Center for Health Statistics (NCHS) is responsible for collecting and disseminating the data for live birth and fetal death. The information in the Birth dataset is abstracted from birth certificates filed in the vital statistics offices of each state and contains information on all births occurring within the United States. The Fetal Death dataset contains the information on all U.S. fetal deaths or stillbirths (defined as spontaneous intrauterine death of a fetus at ≥20 weeks' gestation).[10] Both data files include information about sociodemographic and health characteristics, as well as maternal risk factors associated with each birth (live or stillbirth). The information on maternal prepregnancy BMI was available in both datasets only from 2014 onward. Therefore, we only included data from 2014 to 2019 to conduct this study.

Additionally, only variables available in both the Birth Data and the Fetal Death datasets were included in the analysis: gestational age, maternal prepregnancy BMI, mother's age, race, maternal education, birth facility, prenatal care, delivery method, birth attendant and, fetal sex. Maternal prepregnancy BMI was categorized into the following subgroups: underweight, <18.5; normal, 18.5–24.9; overweight, 25.0–29.9; obesity type I, 30.0–34.9; obesity type II, 35.0–39.9, and obesity type III, ≥40.0. We restricted our analysis to mothers characterized as "normal" or "obese" in this study.

Maternal age was categorized as follows: under 20, 20–29, 30–39, and ≥40 years. Maternal race was categorized as non-Hispanic White (NH-White), NH-Black, Hispanic, or others. Educational attainment was grouped as "less than high school" and "high school graduate, GED completed or higher." Birth facility included categories of "hospital" and "others," and birth attendants were subgrouped into "medical professionals" and "others." We restricted the study to singleton birth within the gestational age of 20 to 42 weeks. Prenatal care was categorized as "starting in first trimester," "starting in second or third trimester," and "no prenatal care." Delivery method was subgrouped as vaginal or by C-section.

All statistical analyses were performed using R (version 3·5·1) and RStudio (Version 1.1.423). Pearson's chi-squared tests were run to identify differences in birth characteristics to women who were of normal (nonobese) BMI versus those who were obese. We then calculated the prevalence of prepregnancy maternal obesity by sociodemographic and birth-related characteristics. Next, we computed the rate of stillbirth per 1,000 births by maternal BMI subgroups. Finally, we used the Cox proportional hazards regression model to compute adjusted hazard ratios (HR) as a measure of risk of

stillbirth in relation to maternal BMI, with normal (nonobese) maternal BMI being the referent category. All tests of hypothesis were two-tailed with a type 1 error rate fixed at 5%. The study was performed using publicly available deidentified data and it was approved as exempt by the Institutional Review Board of Baylor College of Medicine.

Results

In this study, we analyzed 14,938,384 total births from 2014 to 2019. Of this number, 5,632,775 births occurred among women with obesity (37.7%) and 9,305,609 (62.3%) in women with a normal (nonobese) prepregnancy BMI. Among women with obesity, the majority in the study population were NH-White, 20 to 29 years of age, completed high school or higher, sought prenatal care in the first trimester of pregnancy, and had a vaginal delivery of a male fetus at a hospital.

►Table 1 displays the sociodemographic characteristics of the study population by two BMI categories: normal versus obese prepregnancy BMI, along with the within-group prevalence of obesity for each sociodemographic variable (i.e., prevalence of obesity within each variable subcategory). Among women ≥40 years, the within-group prevalence of obesity was 41.8%, while the within-group prevalence of obesity among adolescent mothers (<20 years) was 26.2%. The within-group prevalence of obesity among NH-Blacks was 52.1%, and higher than the within-group prevalence rates for all other racial/ethnic groups studied. When considering the delivery method, the within-group prevalence of obesity was 50.2% among women who delivered by C-section, whereas the within-group prevalence of obesity was lower among women who delivered vaginally (32.2%).

►Fig. 1 shows stillbirth rates per 1,000 total births, overall and by maternal prepregnancy BMI status. Overall, the stillbirth rate was 6.70 per 1,000 births among women with a prepregnancy obesity, almost twice the rate found among women with a normal (nonobese) prepregnancy BMI (3.85 per 1,000 births). Across obesity subgroups, the rates of stillbirth increased with ascending severity of obesity, with the highest rate among women with an obesity type 3 prepregnancy BMI (8.36 per 1,000 births).

The association between several maternal–fetal characteristics and stillbirth is shown in ►Table 2. The risk of stillbirth was greater among women with obesity compared with women without obesity (HR: 1.39; 95% CI: 1.37–1.41). Another maternal–fetal characteristic associated with an increased likelihood of stillbirth was maternal age ≥40 years with an HR of 1.16 (95% CI: 1.11–1.21). Compared with NH-whites, women identifying as NH-other (HR: 1.66; 95% CI: 1.61–1.72) and NH-Black (HR: 1.31; 95% CI: 1.26–1.35) were at higher risk of stillbirth, while Hispanic women had a decreased likelihood of stillbirth (HR: 0.38; 95% CI: 0.37–0.40). Women with a higher level of education beyond high school, delivery in a nonhospital health facility, early entry into prenatal care, vaginal as opposed to cesarean birth, and fetal female sex were at decreased risk of stillbirth.

►Fig. 2 displays the independent association between obesity subgroups and stillbirth with adjustment for maternal sociodemographic and birth-related variables as listed in ►Table 2. All obesity subgroups showed an association with stillbirth when compared with normal (nonobese) BMI in a dose-response pattern with obesity type 3 showing the strongest association (HR: 1.48; 95% CI: 1.45–1.52) followed by obesity type 2 (HR: 1.41; 95% CI 1.38–1.45) and type 1 (HR: 1.35; 95% CI: 1.32–1.37).

Discussion

We analyzed the 2014 to 2019 nationally representative birth and fetal death data obtained from the NVSS to determine the racial/ethnic disparities in the risk of stillbirth among U.S. women with obesity. With an overall stillbirth rate of 6.70 per 1,000 births among women with a prepregnancy obesity, our results demonstrate a progressive increase in stillbirth rates with ascending severity in maternal prepregnancy BMI. Consistent with other research,[6,15–18] we also found an increased likelihood of stillbirth among women ≥40 years, and those identifying as NH-other and NH-Black race/ethnicity.

Our findings also demonstrate a racial disparity in the rate of stillbirth among obese pregnant women. NH-Black women were more likely to be obese and more susceptible to stillbirth associated with obesity compared with NH-White women. This could be explained by the differences in incidence of obesity and obesity-related comorbidities between the two racial groups.[19] For example, diabetes and hypertension tend to be associated with obesity in a dose-related fashion,[20] and hypertension is more prevalent and often goes undiagnosed in NH-Blacks.[21] Black women have also been shown to experience higher rates of placental dysfunction related to hypertensive disorders in pregnancy, as well as the antecedent increased risk of in utero mortality. Another proposed mechanism for this disparity, and one worth investigating further, is the possible difference in availability of antenatal health surveillance and the uptake and quality of such services between the two racial groups.

Although our study, along with several others have demonstrated a clear association between obesity and an increased risk of stillbirth, the pathophysiology and exact mechanism underlying this observed association is unclear. It is probable, however, that this association is multifactorial and the result of a complex interplay of factors. Such factors may include a heightened inflammatory response, utero-placental insufficiency and abnormal metabolic profile in the mother.[17] Obesity may also have a role, given that it is associated with several risk factors for stillbirth including diabetes, hypertensive disorders, advanced maternal age, fetal growth abnormalities, and postmaturity.[17] Additionally, some investigators have suggested that increased apneic–hypoxic events among obese women play an important role,[6,22] in that these events could lead to pregnancy-induced hypertensive disorders and fetal growth restriction, which elevate the risk of fetal loss.[22]

Table 1 Sociodemographic and birth-related characteristics of women of normal (nonobese) and obese prepregnancy BMI categories, United States, 2014–2019

	Normal		Obese		Within-group prevalence
	n = 9,305,609	% = 62.3	*n* = 5,632,775	% = 37.7	%
Maternal age					
< 20 y	587,939	6.3%	208,623	3.7%	26.2
20–29 y	4,479,479	48.1%	2,894,739	51.4%	39.3
30–39 y	3,972,185	42.7%	2,338,610	41.5%	37.1
≥40 y	266,006	2.9%	190,803	3.4%	41.8
Race					
NH-White	5,228,889	56.2%	2,686,539	47.7%	33.9
NH-Black	998,455	10.7%	1,085,608	19.3%	52.1
Hispanic	1,886,903	20.3%	1,465,490	26.0%	43.7
NH-Others	1,166,613	12.5%	370,617	6.6%	24.1
Missing	24,749	0.3%	24,521	0.4%	49.8
Education					
Less than high school	1,130,235	12.6%	785,620	14.6%	41.0
High school graduate, GED or higher	8,060,188	86.2%	4,783,658	84.4%	37.2
Unknown	115,186	1.2%	63,497	1.1%	35.5
Birth facility					
Hospital	9,100,173	97.8%	5,585,596	99.2%	38.0
Others	205,007	2.1%	47,010	0.8%	18.7
Unknown	429	0.0%	169	0.0%	28.3
Prenatal care					
First trimester	7,085,398	76.1%	4,245,552	75.4%	37.5
Second or third trimester	1,856,746	20.1%	1,190,121	21.4%	39.1
No prenatal care/missing	363,465	4.0%	197,102	3.6%	35.2
Delivery method					
Vaginal	7,025,847	75.5%	3,332,835	59.2%	32.2
C-section	2,275,465	24.5%	2,297,165	40.8%	50.2
Missing	4,297	0.0%	2,775	0.0%	39.2
Birth attendant					
Medical professionals	9,113,215	99.1%	5,565,609	98.8%	37.9
Other	186,578	2.0%	64,112	1.1%	25.6
Unknown	5,816	0.1%	3,054	0.1%	34.4
Sex of fetus					
Female	4,535,550	48.7%	2,751,290	48.8%	37.8
Male	4,769,797	51.3%	2,881,268	51.2%	37.7
Missing	262	0.0%	217	0.0%	45.3

Abbreviations: BMI, body mass index; GED, General Educational Development; NH, non-Hispanic.

Further, the observed association between obesity and stillbirth may also be explained by the significantly lower levels of pregnancy-associated plasma protein A (PAPP-A) found in women with obesity compared with those without obesity.[23] PAPP-A is a placental enzyme, which releases insulinlike growth factor (IGF) from its carrier protein, increasing the proportion of active IGF; both IGF and insulin are crucial for fetal growth.[23] It is possible that the lower levels of PAPP-A observed in obese pregnant women reflect a suboptimal placentation.[24] Signs of placental immaturity and placental changes implicating an aging placenta are more often seen in pregnancies with obesity,[25] and may also contribute to the increased risk of fetal demise.

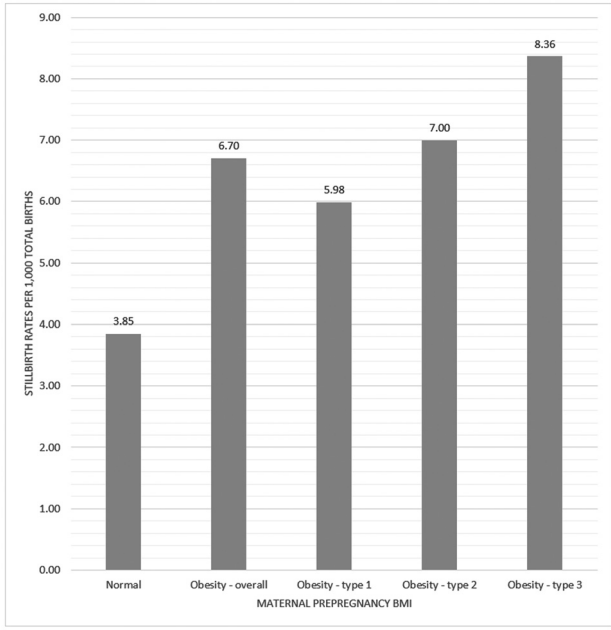

Fig. 1 Stillbirth rates, overall and by maternal prepregnancy body mass index (BMI) category, per 1,000 births in the United States, 2014–2019.

Limitations and Strengths

Despite the insightful results generated, this study is not without limitations. Data for this study were obtained from two NVSS datasets, the Birth Data and Fetal Death datasets. As a result, we could only analyze data common to both datasets. While the methods employed in our analysis adjusted for confounding factors, unmeasured confounding factors, which were not available for analysis, such as genetic influences, specific dietary factors, or fetal risk factors, could have impacted the risk of stillbirth in these women. This study was also constrained by pertinent missing data, such as race and prenatal care information. Another limitation of this study was sampling bias, as a majority of the sampled women were NH-White women ($n = 7{,}915{,}428$), while NH- Black women were only a fraction of that ($n = 2{,}084{,}063$). This might have impacted our results considering that another study by the CDC showed that the highest percentage of women who entered pregnancy obese was among NH-Black women (39.1%), compared with 26.6% in NH-White women.[26]

Yet, notwithstanding these limitations, one major strength of this study was the large sample size and analysis of nationally representative data, thereby increasing the generalizability of the results. Additionally, another strength of the study is that it adds to the literature by providing a vivid and comprehensive picture of maternal characteristics during pregnancy, delivery conditions, sex of the fetus, as well the association between obesity and stillbirth among women in the United States.

Conclusion

Our study highlights areas to be explored in reducing the prevalence of obesity and the associated risk of stillbirth. Obesity is a modifiable risk factor for stillbirth, and public health campaigns creating awareness on the negative impact of obesity in pregnancy and birth outcomes are needed. Strategies targeting weight management in women of reproductive age and racial/ethnic populations at highest risk of stillbirth and other

Table 2 Adjusted[a] hazard ratios (HR) and 95% confidence intervals (CIs) representing the association between maternal prepregnancy sociodemographic and birth-related characteristics and stillbirth among women in the United States, 2014–2019

	Adjusted HR[a] (95% CI)	*p*-value
Maternal BMI		
Normal	Reference	
Obese	1.39 (1.37–1.41)	<0.01
Maternal age		
< 20 y	Reference	
20–29 y	0.93 (0.9–0.96)	<0.01
30–39 y	0.94 (0.91–0.97)	<0.01
≥40 y	1.16 (1.11–1.21)	<0.01
Race		
NH-White	Reference	
NH-Black	1.31 (1.26–1.35)	<0.01
Hispanic	0.38 (0.37–0.4)	<0.01
NH-Others	1.66 (1.61–1.72)	<0.01
Education		
Less than high school	Reference	
High school graduate, GED completed or higher	0.62 (0.61–0.63)	<0.01
Birth facility		
Hospital	Reference	
Others	0.86 (0.81–0.91)	<0.01
Prenatal care		
First trimester	Reference	
Second or third trimester	0.83 (0.82–0.85)	<0.01
No prenatal care	1.19 (1.17–1.22)	<0.01
Delivery method		
C-section	Reference	
Vaginal	1.51 (1.44–1.58)	<0.01
Birth attendant		
Medical professionals	Reference	
Other	0.96 (0.91–1.01)	0.26
Fetal sex		
Female	Reference	
Male	1.02 (1.01–1.04)	<0.01

Abbreviations: BMI, body mass index; GED, General Educational Development; NH, non-Hispanic.

[a]Hazard ratio estimates generated from model adjusted for age, race, education, birth facility, prenatal care, delivery method, birth attendant, and fetal sex. All results, with the exception of birth attendant, were statistically significant at $p < 0.01$.

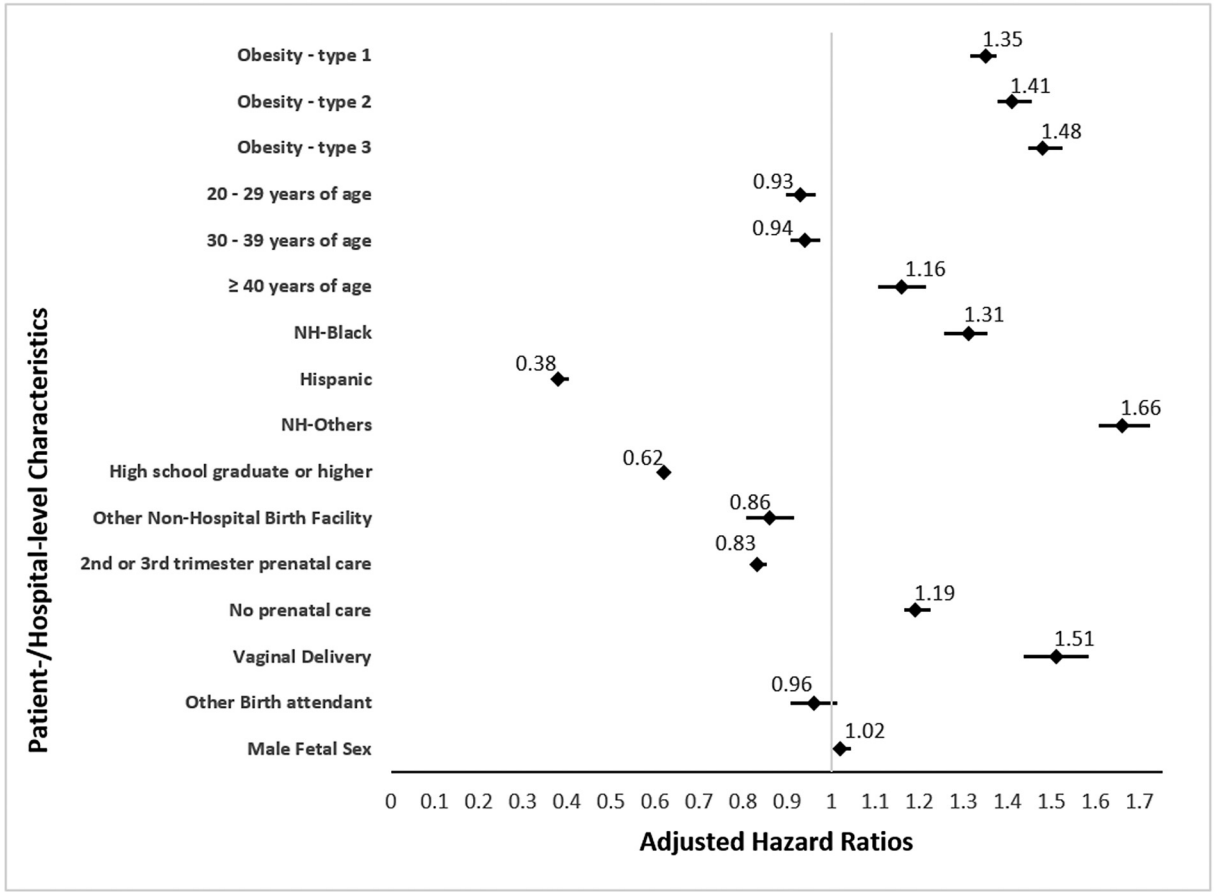

Fig. 2 Adjusted* hazard ratios (HR) and 95% confidence intervals (CIs) representing the association between maternal prepregnancy sociodemographic and birth-related characteristics, including obesity subgroups and stillbirth among women in the United States, 2014–2019. NH, non-Hispanic. *Hazard ratio estimates generated from model adjusted for age, race, education, birth facility, prenatal care, delivery method, birth attendant, and fetal sex. All results, with the exception of birth attendant, were statistically significant at $p < 0.01$.

adverse outcomes prior to conception and postnatal will also be beneficial. An antenatal surveillance program to identify pregnancies with increased risk of stillbirth could be generated with some of the factors analyzed in this study.

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Conflict of Interest

None declared.

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