Prepregnancy Obesity and Birth Defects In Rhode Island

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Obesity is a chronic condition linked with diabetes, stroke, coronary artery disease, and hypertension. [1] The estimated prevalence of obesity in the United States (26.7%) and Rhode Island (24.9%) has increased over the past decades.[2,3] Obese women are at increased risk for pregnancy complications and poor birth outcomes. Specifically, prepregnancy obesity has been associated with birth defects, especially neural tube defects and congenital heart defects. [4] However, less is known about the relationship of obesity with birth defects in Rhode Island.

Methods

A case-control study was conducted among Rhode Island births during 2007-2009. Cases were defined as newborns born during 2007-2009 at Women & Infants Hospital (Providence, RI) and Kent Hospital (Warwick, RI) with at least one diagnosed birth defect. A birth defects case was identified using ICD-9 (International Statistical Classification of Diseases, 9th Edition) codes 740-759, and 760.71. Controls were defined as Rhode Island resident births born in 2007-2008 with no diagnosed birth defect. Controls were taken from the Rhode Island **Pregnancy Risk Assessment Monitoring System (PRAMS),** a survey that asks new mothers about behaviors and experiences before, during and after pregnancy.

Prepregnancy obesity was based on height (cm) and prepregnancy weight (kg) of the mother to calculate a body mass index (kg/cm^2). Obesity is defined as having a **body mass index (BMI)** >30. Height and pre-pregnant weight data for cases were collected through prenatal care documents via medical chart review. Height and prepregnant weights for controls were collected from PRAMS survey responses (self-reported data). Cases and controls that did not have both maternal height and/or prepregnant weight data were excluded. Demographics for cases and controls were examined and significant differences were identified for analytical adjustment. To compare population characteristics between study cases and controls, weighted PRAMS percentages were calculated to reflect Rhode Island population distribution.

Data were analyzed by birth defects body systems (cardiovascular, musculoskeletal, etc.). The cardiovascular birth defects body system was further classified into structural groups of congenital heart defects (conotruncal, septal, and obstruction). Logistic regression was used to analyze the relationship between prepregnancy obesity and birth defects outcomes, controlling for diabetes mellitus and low birth weight to produce an adjusted **odds ratio estimate (aOR).** Pre-gestational diabetes was collected through medical chart review for the cases and collected through PRAMS responses for the controls. Gestational diabetes was not included in this analysis since it develops during pregnancy. Low birth weight is defined as less than 2,500 grams (~5.5 lbs). Statistical analysis was performed using SAS software.

Results

Of the 1,317 potential birth defects study cases for 2007-2009, 995 (76%) had maternal heights and prepregnancy weights for BMI calculation, and were included in the study. Among 2,668 PRAMS respondents from 2007-2008, 2,521 (95%) had maternal heights and weights for BMI calculation. Among this group, 2,344 (93%) did not have a birth defect, and were included in the study.

Table 1 Demographic Characteristics of Study Cases and Controls

Variable	Cases (n=995) n (%)	Controls (n=2344) n* (%**)
Obese (BMI ≥ 30)		
Yes	233 (23.4)	503 (17.1)
No	762 (76.6)	1841 (82.1)
Diabetes		
Yes	31 (3.1)	102 (1.7)
No	963 (96.9)	2242 (96.3)
Birth Weight		
Low BW	162 (16.3)	928 (7.2)
Normal BW	833 (83.7)	1416 (92.8)
Gestational Age		
Preterm	192 (19.3)	714 (8.4)
Term	799 (80.3)	1621 (91.4)
Sex		
Male	599 (60.2)	1145 (51.4)
Female	394 (39.6)	1193 (48.6)
Maternal Age		
< 20	115 (11.6)	227 (10.5)
20 - 34	680 (68.3)	1690 (72.9)
> 34	200 (20.1)	419 16.6)
City/Town		
*Core****	493 (49.5)	1219 (47.9)
Non-Core	502 (50.5)	1009 (52.1)
Race/Ethnicity		
White	578 (58.1)	1427 (57.0)
Black	134 (13.5)	225 (9.4)
Hispanic	233 (23.4)	454 (20.3)
Native	5 (0.5)	29 (1.4)
Asian	33 (3.3)	103 (2.8)
Other	12 (1.2)	37 (1.7)
Insurance		
Public	509 (51.2)	1102 (47.1)
None	15 (1.5)	18 (0.4)
Private	470 (47.2)	1210 (47.7)
Education		
< 12th	194 (19.5)	376 (16.3)
12th	271 (27.2)	671 (29.6)
> 12th	461 (46.3)	1167 (49.1)
Unknown	69 (6.9)	130 (5.0)

**Unweighted PRAMS numbers*
***Weighted PRAMS percentages*
****Towns with more than 15% of children live in poverty*

Table 2 Association between prepregnancy obesity and birth defects in Rhode Island, 2007-2009

	Cases (n)	Unadjusted	Adjusted*	p-value
Overall birth defects	995	1.12 (0.94 - 1.34)	1.18 (0.98 - 1.42)	.07
NBDPN 45 anomalies**	473	1.30 (1.04 - 1.63)	1.38 (1.09 - 1.74)	**.008**
Cardiovascular defects	235	1.37 (1.01 - 1.86)	1.43 (1.05 - 1.95)	**.02**
septal heart defects	157	1.34 (0.93 - 1.93)	1.38 (0.95 - 2.00)	.09
conotruncal heart defects	62	1.88 (1.10 - 3.20)	1.88 (1.09 - 3.24)	**.02**
obstruction heart defects	21	1.83 (0.75 - 4.56)	2.07 (0.83 - 5.16)	.11
Orofacial defects	28	1.73 (0.78 - 3.86)	1.96 (0.88 - 4.36)	.10
Genitourinary defects	145	1.00 (0.66 - 1.50)	1.03 (0.67 - 1.57)	.90

* Pre-gestational diabetes and low birth weight (≤ 2500 g)

** 45 congenital anomalies selected by the National Birth Defects Prevention Network

Table 1 shows the population characteristics of study cases and controls by selected demographics. Among 995 birth defects cases, 233 (23.4%) were obese prior to becoming pregnant. This is higher than the controls, where 17.1% were obese prior to their pregnancy. Low birth weight and preterm delivery rates among the cases (16.3% and 19.3%, respectively) were more than twice the rates of the control group (7.2% and 8.4%, respectively). There were a higher proportion of males among the case group (60.2%) compared to the controls (51.4%). Other demographic variables such as maternal age, core city status, and maternal education show a fairly similar population distribution across specific subpopulations among cases and controls.

Table 2 shows the measures of association between pre-pregnancy obesity and selected birth defects groups adjusted for diabetes and low birth weight. A subset of 45 birth defects categorized as severe and important by the **National Birth Defects Prevention Network** (www.nbdpn.org) shows an aOR of 1.38 (1.09 – 1.74). Cardiovascular defects also show a relationship with prepregnancy obesity with an aOR of 1.43 (1.05 – 1.95). After classifying these cardiovascular defects into three congenital heart defects groups (septal, conotruncal, and obstruction), conotruncal heart defects showed a higher degree of association with prepregnancy obesity (aOR = 1.88, CI 1.09 – 3.24) than the other heart defects groups. There were no significant findings among other body system groups such as orofacial and genitourinary defects.

Discussion

Conotruncal defects are a group of congenital heart defects that show the strongest association with pre-pregnancy obesity in this study. During the 4th week of gestation, a fetal structure called the conotruncus is formed. This structure is the basis for the development of main vessels connecting to the heart, which can lead to their subsequent birth defects outcomes such as transposition of great vessels and truncus arteriosus. The close temporal proximity of the conotruncus to prepregnancy obesity exposure provides a stronger link than with birth defects that arise from other fetal structures occurring later in fetal development. Another study has also shown a link between severe obesity and conotruncal heart defects.[5]

Research has shown that diabetes is strongly associated with birth defects.[6] Although adjusting for diabetes is necessary to find an association with pre-pregnancy obesity and birth defects, it was used with caution for this analysis since there was a small sample of diabetics among cases. Diabetes was also slightly higher among the controls than cases, presenting a problem for this study to control for diabetes.

Although there was enough power to conduct this study with all birth defects, the sample size was insufficient to analyze small groups of birth defects (e.g., obstruction heart defects and neural tube defects). Also, different data collection methods were used for cases (nurse reporting via medical charts) versus controls (self-reported questionnaire). There was also variation in the percentage of subject exclusion due to missing heights and pre-pregnancy weights and therefore, insufficient BMI information, among cases (25%) and controls (5%). Lack of recording heights and prepregnancy weights in prenatal care documents may be due to varying prenatal care practices.

This study and other research show that women who are obese prior to their pregnancy are at greater risk for having a baby with a birth defect. It is therefore important for women to be educated prenatally about the risks of pre-pregnancy obesity on birth outcomes.

In addition to concerns about obesity and its impact on maternal and child health, there are also medical costs related to maternal obesity and birth defects. Obese pregnant women have more prenatal fetal tests, ultrasound examinations, and prenatal visits than pregnant women of normal weight.[7] Hospitalization costs incurred among women who give birth to children with birth defects are seven times higher than women who give birth to children with no birth defects.[8]

Primary care providers, obstetricians and gynecologists, and other health care providers can play a critical role in educating women of reproductive age about the importance of achieving a healthy weight prior to becoming pregnant.

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Disclosure of Financial Interests

The authors and/or significant others have no financial interests to disclose.