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CLINICAL ARTICLE

Maternal obesity and neonatal congenital cardiovascular defects

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Abstract

Objective: To determine whether isolated congenital heart defects (CHDs) were associated with maternal obesity. *Method:* In a retrospective study we compared the incidence and severity of isolated CHDs in the offspring of 428 women divided into 3 groups, one of women of normal weight (n=141), one of obese women (n=228), and one of morbidly obese women (n=59) according to their body mass index. *Results:* There were 143 mild (66.8%), 44 moderate (20.6%), and 27 complex (12.6%) forms of CHDs in the offspring and septal defects were the most common (61.7%). No significant differences were found among the 3 groups of women regarding the type or severity of CHDs in their respective offspring, or the corrective cardiac surgery required. *Conclusion:* No association was found between maternal weight and isolated CHDs in the offspring.

1. Introduction

The dramatic increase in the prevalence of overweight and obese women of childbearing age in recent years has been recognized as an important public health problem. Obesity has been associated with pregnancy complications and increased rates of birth defects [1,2]. Several investigators found a strong association, with odds ratios (ORs) ranging from 1.33 to 2.1, between a prepregnancy BMI of 25 or greater (calculated as weight in kilograms divided by the square of height in meters) and isolated or multiple structural birth defects such as anencephaly, spina bifida, heart defects, anorectal atresia, and hypospadias in the offspring [3–10]. The biological mechanisms that may link obesity and birth defects are unknown. Although several investigators have shown a lack of folic acid supplementation before conception and in early pregnancy to be strongly associated with neural tube defects in the offspring [3–6], prepregnancy obesity as a possible risk factor for birth defects remains to be investigated. Heart defects are among the most common congenital abnormalities with life-threatening consequences. The reported CHD prevalence 0.85% to 1.00% of all live births contributes to 30% to 40% of all deaths during infancy and early childhood [1,11,12]. Many forms and types

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of CHD exist. The prognosis, morbidity, and mortality are dependent on the type, size, location, and number of defects and associated anomalies. With mild cardiac defects the newborn appears to be healthy at birth and the only sign is a mild heart murmur. Most of these mild defects do not require treatment and only periodic visits to a cardiologist are necessary; moderate defects do not require immediate surgery and may require observation and/or medical treatment initially and a surgical intervention later; while major defects require immediate resuscitation and admission to the intensive care unit, and may require immediate surgical attention. Known predisposing factors are a chromosomal defect in the fetus or maternal causes such as infection during pregnancy (eg, by the rubella or the human immunodeficiency virus); uncontrolled diabetes mellitus before and during pregnancy; drug intake during pregnancy (eg, anticonvulsants, busulfan, or lithium); and perhaps maternal obesity [1,11,12]. Whether CHDs are associated with obesity alone has been poorly studied. As obesity can now be considered a world epidemic, it is important to determine whether prepregnancy obesity can be at the origin of isolated CDHs. The objective of this retrospective case-control study was to test for an association between prepregnancy obesity and an increased risk of CHDs in the offspring.

2. Methods

We reviewed registry data collected for all infants born with isolated CHDs at King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia, between 1998 and 2005. Diagnosis was based on clinical assessment and, if needed, detailed cardiac work-up with echocardiography, cardiac catheterization, and cardiac surgery. The 214 isolated CHDs identified were grouped as mild, moderate, and complex (Table 1). Mean maternal characteristics such as age, height, prepregnancy weight and BMI, periconceptional multivitamin intake, pregnancy duration, number of preterm births ($\leq$36.6 weeks) and term deliveries ($\geq$37 weeks), number of singleton and multiple pregnancies, medical conditions before and during pregnancy, medication intake, viral infections incurred during pregnancy, previous delivery of a child with CHD(s), and family history were recorded and compared between BMI groups (Table 2). To ensure that we only tested for an association between maternal obesity and CHDs in the offspring, we excluded from analysis all women who had prepregnancy diabetes mellitus (whether insulin dependent or not), gestational diabetes, or epilepsy; who were infected with known teratogenic viruses such as rubella or HIV during pregnancy; or who received chemotherapy and/or radiotherapy during pregnancy.

Neonatal characteristics such as sex, birth weight, Apgar scores at 1 and 5 minutes, presence and degree of cardiac lesion(s) (mild, moderate, or complex), mode of delivery, need for newborn resuscitation or intubation, and admission to the neonatal intensive care unit were recorded and analyzed, as were the type and time of cardiac surgery, if performed (before or after 1 year of age) and length of hospital stay (Table 3). We excluded from our analysis stillborn infants as well as infants born preterm (<37 completed weeks) with multiple congenital anomalies such as patent ductus arteriosus, chromosomal abnormalities, and single-gene abnormality or a recognized genetic syndrome.

Records from 11 079 deliveries performed between 1998 and 2005 were reviewed. Of the 248 infants with isolated CHDs identified for the study period, 34 were excluded because of maternal prepregnancy insulin-dependent (n = 10) or non–insulin-dependent diabetes (n = 8), or because of Down syndrome (n = 14) or Noonan syndrome (n = 2). The 214 infants with isolated CHDs who were retained for the study were matched with 214 healthy infants delivered during the same period at our center. The 429 mothers were grouped based on their BMI. A control group consisted of 141 women of normal weight (BMI, 19.00–25.00), and there was a group of 228 obese women (BMI, 30.00–34.99) and a group of 59 morbidly obese women (BMI $\geq$ 35). The infants' CHDs were divided into groups of mild, severe, and complex defects following previous published reports [13,14] (Table 1).

Data were analyzed by analysis of variance for continuous variables, followed by a least-significant-difference post hoc test to compare the mean differences between groups. Two-tailed *t* tests, Fisher exact tests, and χ^2 tests were used, as appropriate, with $P<0.05$ considered statistically significant. Univariate and multivariate logistic regression analyses were used to examine factors such as maternal BMI, age, parity, persisting congenital heart disease; previous child with CHD(s);

Table 1 Isolated congenital heart defects in 214 newborns [a]

Mild defect		Moderate defect		Complex defect	
ASD	31 (14.5)	Teratology of Fallot	4 (1.9)	ASD + VSD	23 (10.7)
VSD	38 (17.8)	Complete heart block	7 (3.3)	ASD + PDA	25 (12.6)
Patent ductus	18 (8.4)	Hypoplastic right heart	5 (2.3)	VSD + ASD + PDA	8 (3.7)
Aortic valve stenosis	7 (3.3)	Ebstein anomaly	1 (0.5)	ASD + AS	2 (0.9)
Pulmonary stenosis	14 (6.5)	WPW syndrome	2 (0.9)	ASD + TR	5 (2.3)
Mitral regurgitation	2 (0.9)	TGV	5 (2.3)		
SVT	4 (1.9)	Cardiomyopathy	3 (1.4)		
Aortic coarctation	5 (2.3)	Pulmonary atresia	2 (0.9)		
		Cardiac rhabdomyoma	1 (0.5)		
		Long QT syndrome	2 (0.9)		

Abbreviations: AS, aortic valve stenosis; ASD, atrial septal defect; PDA, patent ductus arteriosus; PS, stenosis of pulmonary artery; SVT, supraventricular tachycardia; TGV, transposition of great vessels; TR, tricuspid regurgitation; VSD, ventricular septal defect; WPW, Wolff-Parkinson-White.

[a] Values are given as number (percentage).