

Teratology Public Affairs Committee Position Paper: Maternal Obesity and Pregnancy

Public Affairs Committee of the Teratology Society

Compared to normal-weight women, obese women have an increased risk of infertility and pregnancy complications. The most consistently described pregnancy complications are hypertensive disorders, gestational diabetes mellitus, thromboembolic events, and cesarean section. Fetal and neonatal complications may include congenital malformations, macrosomia, and shoulder dystocia. The literature suggests that women with a body mass index (BMI) ≥ 30 have approximately double the risk of having a child with a neural tube defect (NTD) compared to normal-weight women, and the increased risk associated with higher maternal body weight does not appear to be modified by folic acid supplementation. The Public Affairs Committee of the Teratology Society supports the public health initiatives identified by the U.S. Food and Drug Administration in 2004 and the research initiatives identified by the National Institutes of Health in 2004. The Public Affairs Committee recommends that clinicians counsel women about appropriate caloric intake and exercise and that health-care providers educate parents about appropriate childhood nutrition. Breast-feeding should be encouraged based on evidence of a protective effect against childhood obesity, as well as other health advantages. *Birth Defects Research (Part A) 76:73–77, 2006.* © 2006 Wiley-Liss, Inc.

THE SCOPE OF THE PROBLEM

There is increasing evidence that obesity is a risk factor in pregnancy. Obesity represents an imbalance between energy intake from food and energy output expended as physical and metabolic activity. Even small imbalances over time can result in weight changes. The health effects of body weight are determined based on height adjustment, expressed as the body mass index (BMI, defined as weight in kilograms divided by the square of the height in meters). Overweight is defined as BMI ≥ 25 , and obesity as BMI ≥ 30 . According to the National Center for Health Statistics (2004), in 1999–2000 64% of the U.S. population aged 20–74 was overweight, and almost half of the overweight group was obese. The prevalence of overweight (52%) and obesity (26%) among women aged 20–34 years (the age group most likely to become pregnant) was somewhat lower, but prevalences of overweight and obesity were comparable to the overall population in women aged 35–44. The National Health and Nutrition Examination Survey (NHANES) for 1999–2002 found that 65.7% of Americans over age 20 were overweight or obese, and 30.6% were obese (Hedley et al., 2004). For women aged 20–39, overweight/obesity was identified in 54.5% of the NHANES sample, and obesity was identified in 29.1% of the sample.

Obesity in the general population appears to be increasing. According to the Centers for Disease Control and Prevention (Mokdad et al., 2003), there was a 5.6% increase in Americans with a BMI ≥ 30 between 2000 and 2001, with a concomitant 8.2% increase in the prevalence of diabetes

mellitus. Besides diabetes mellitus, overweight and obesity are significantly associated with hypertension, hypercholesterolemia, asthma, arthritis, and poor health status. In addition to an upward trend in prepregnancy weight, there has also been an increase in excessive pregnancy weight gain (Schieve et al., 1998).

REPRODUCTIVE CONSEQUENCES OF OBESITY IN WOMEN

Compared to normal-weight women, obese women have an increased risk of infertility and pregnancy complications (Table 1). The most consistently described pregnancy complications are hypertensive disorders, gestational diabetes mellitus, thromboembolic events, and cesarean section. The increased risk for cesarean section in obese women has been attributed to dystocia (abnormal labor). In addition to the listed complications, it may be more difficult to perform and interpret diagnostic procedures, such as ultrasonography and fetal echocardiography, in women who are obese (Hendler et al., 2004). Fetal and neonatal complications may also be increased by maternal obesity (Table 2). Of these complications, congenital malformations (discussed below), macrosomia (large body

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Table 1
Possible Reproductive Risks of Obesity in Women

Possible risk	References
Prior to pregnancy	
Infertility	Moran and Norman (2002); Crosignani et al. (2002); Mulders et al. (2003a,b)
Pregnancy	
Miscarriage	Lashen et al. (2004); Mulders et al. (2003a)
Chronic hypertension and pre-eclampsia	Sebire et al. (2001); O'Brien et al. (2003); Cedergren (2004); LaCoursiere et al. (2005); Rode et al. (2005); Robinson et al. (2005)
Thromboembolic disease	Castro and Avina (2002); Greer (2004); Colman-Brochu (2004); Robinson et al. (2005)
Sleep apnea	Castro and Avina (2002)
Gestational diabetes/glucose intolerance	Farmer et al. (1992); Sebire et al. (2001)
Urinary tract infection	Galtier-Dereure et al. (1995); Sebire et al. (2001); Usha Kiran et al. (2005)
Labor and delivery	
Increased incidence of labor induction	Johnson et al (1987); Sebire et al. (2001); Vahratian et al. (2004); Usha Kiran et al. (2005); Robinson et al. (2005)
Increased incidence of cesarean section	Sebire et al. (2001); Galtier-Dereure & Bringer (2002); Kaiser & Kirby (2001); Sheiner et al. (2004a); Weiss et al. (2004); Cedergren (2004); LaCoursiere et al. (2005); Rode et al. (2005); Usha Kiran et al. (2005); Robinson et al. (2005)
Postsurgical wound infection	Beattie et al. (1994); Sebire et al. (2001); Chauhan et al. (2001); Myles et al. (2002); Wall et al. (2003); Robinson et al. (2005)
Postpartum endometritis	Perlow and Morgan (1994); Myles et al. (2002); Carroll et al. (2003)
Poor lactational outcomes	Sebire et al. (2001); Li et al. (2003); Hilson et al. (2004); Rasmussen and Kjolhede (2004)

size), and shoulder dystocia have been the most consistently documented.

In a retrospective study in France, Galtier-Dereure et al. (1995) found that the hospital cost for prenatal care for overweight women exceeded that for normal-weight control subjects by 5.4- to 16.2-fold, depending on the degree of obesity. In a prospective follow-up study, the same group found that the average cost of hospital prenatal care was 5 times higher in mothers who were overweight before pregnancy than in normal-weight control women (Galtier-Dereure et al., 2000). Women with a prepregnancy BMI of 29 stayed in the hospital an average of 4.43 more days than normal-weight women. The percentage of infants requiring admission to a neonatal intensive care unit was 3.5 times higher when the mother was obese than when she was not obese. Obesity was found to lead to significantly longer postpartum hospital stays as a result of

both more frequent cesarean deliveries and a higher incidence of surgical complications.

Since Waller et al. (1994) first reported that maternal obesity was associated with an increased risk for neural tube defects (NTDs), numerous studies have confirmed that finding. The literature suggests that compared to normal-weight women, women with a BMI ≥ 30 have approximately double the risk of having an affected child. Women who are overweight but not obese may have a slightly increased risk compared to normal-weight women, but the data are less consistent in this regard. Some studies have shown that the risk of having an infant with an NTD increases with increasing weight. Of note, the increased risk associated with higher maternal body weight does not appear to be modified by folic acid supplementation (Werler et al., 1996; Ray et al., 2005), nor can it be explained by maternal diabetes, which is more common in obese women

Table 2
Possible Offspring Risks Associated with Maternal Obesity

Condition	References
Prenatal	
Neural tube defects	Waller et al. (1994); Prentice and Goldberg (1996); Shaw et al. (1996); Watkins et al. (1996); Werler et al. (1996); Watkins et al. (2003)
Heart defects	Watkins et al. (2003); Cedergren & Källén (2003); Mikhail et al. (2002)
Other birth defects	Queisser-Luft et al. (1998); Watkins et al. (2003)
Stillbirth	Cedergren (2004); Nohr et al. (2005)
Multiple congenital anomalies	Shaw et al. (2002); Watkins et al. (2003)
Neonatal	
Neonatal death	de Groot (1999); Huang et al. (2000); Cnattingius et al. (1998); Fraen et al. (2002); Stephansson et al. (2001); Cedergren (2004)
Macrosomia	Cedergren (2004); LaCoursiere et al. (2005); Rode et al. (2005); Usha Kiran et al. (2005)
Shoulder dystocia/birth trauma ^a	Carlan et al. (1991); Andreassen et al. (2004); Cedergren (2004); Usha Kiran et al. (2005)
Meconium aspiration	Cedergren (2004)
Early Childhood	
Juvenile obesity	Bergmann et al. (2003); Whitaker (2004)

^aNot all authors have associated obesity with birth trauma (e.g., Sheiner et al., 2004a).

Table 3.
Recommendations of the FDA Obesity Working Group (FDA, 2004).

Food Labeling

- **Calories:** Issue an advance notice of proposed rulemaking (ANPRM) to solicit public comment on how to give more prominence to calories on the food label. As examples, increasing the font size for calories, including a percent Daily Value (%DV) column for total calories, and eliminating the listing for calories from fat.
- **Serving Sizes:** Encourage manufacturers immediately to take advantage of the flexibility in current regulations on serving sizes and label as a single-serving those food packages where the entire content of the package can reasonably be consumed at a single-eating occasion. For example, a 20-oz bottle of soda that currently states 110 calories per serving and 2.5 servings per bottle could be labeled as containing 275 calories per bottle.
- **Carbohydrates:** File petitions and publish a proposed rule during summer 2004 to provide for nutrient content claims related to carbohydrate content of foods, including guidance for use of the term "net" in relation to the carbohydrate content of foods.
- **Comparative Labeling Statements:** Encourage manufacturers to use appropriate comparative labeling statements that make it easier for consumers to make healthy substitutions, including calories (e.g., "instead of cherry pie, try our delicious low fat cherry yogurt—29 percent fewer calories and 86 percent less fat").

Enforcement Activities

- Together with the Federal Trade Commission (FTC), increase enforcement against weight loss products having false or misleading claims.
- Consider enforcement action against products that declare inaccurate serving sizes.

Educational Partnerships

- As part of a larger DHHS effort, establish relationships with, among others, youth-oriented organizations such as the Girl Scouts of the USA, the National Association of State Universities and Land Grant Colleges (4-H program), to educate Americans about obesity and leading healthier lives through better nutrition.

Restaurants

- Urge the restaurant industry to launch a nation-wide, voluntary, and point-of-sale nutrition information campaign for consumers.

Therapeutics

- Convene a meeting of a standing FDA advisory committee meeting to address challenges, as well as gaps in knowledge, about existing drug therapies for the treatment of obesity.
- Revise 1996 draft guidance on developing obesity drugs and re-issue for comment.

Research

- Support and collaborate, as appropriate, on obesity-related research with others, including NIH.
 - Pursue research on obesity prevention with U.S. Department of Agriculture/Agricultural Research Service (USDA/ARS).
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and is independently associated with an increased risk for NTDs and other anomalies. Although periconceptional diets with a high glycemic index have been associated with NTDs (Shaw et al., 2003), metabolic abnormalities other than hyperglycemia, including hyperinsulinemia and poor diet, have been suggested to be important factors in obesity-associated NTD risk (Hendricks et al., 2001).

The relationship between obesity and other birth defects remains unclear. It is difficult to gather enough cases of many defects to draw definitive conclusions. There are a limited number of studies of most defects, and some of the positive findings in the literature may have occurred by chance due to multiple comparisons. Nonetheless, some studies suggest that obesity causes an increase in total malformations, multiple malformations, and malformations in several different organ systems, including the cardiovascular, craniofacial, and genitourinary systems. Paradoxically, periconceptional weight loss regimens also may impose a risk of having an infant with an NTD (Robert et al., 1995; Carmichael et al., 2003), which suggests that weight reduction efforts should be made well before pregnancy is attempted, and pregnancy be avoided while a woman is dieting.

CURRENT INITIATIVES

In 2001 the Surgeon General issued a Call to Action to decrease the incidence of overweight and obesity (U.S. Department of Health and Human Services, 2001). In 2003 the U.S. Food and Drug Administration created an Obesity Working Group, which issued a report in 2004 (FDA Obesity Working Group, 2004). Although not directed specif-

ically toward pregnant women, the Obesity Working Group report contained specific recommendations designed to address the obesity problem in general (Table 3). In 2004 the NIH developed and released a Strategic Plan for NIH Obesity Research (NIH, 2004) in which pregnancy was acknowledged as an important subject for attention. The Canadian Institutes of Health Research (2004) also announced the importance of obesity research in its overall research agenda.

RECOMMENDATIONS

The Public Affairs Committee views obesity as a pregnancy risk factor and supports the public health initiatives identified by the FDA Obesity Working Group (2004) and the research initiatives identified by the NIH (2004). In addition, the Public Affairs Committee notes the following recommendations.

Adequate nutrition is important for pregnant women and women planning a pregnancy. Although most attention has been focused on adequacy of folic acid intake during the periconceptional period, obesity prevention and management is another aspect of nutritional adequacy. Just as clinicians have been encouraged to counsel women who are pregnant or may become pregnant about folic acid, smoking cessation, and avoidance of ethanol intake, the Public Affairs Committee recommends that clinicians counsel women about appropriate caloric intake and exercise. Prepregnancy and early pregnancy dietary counseling of obese women includes education about the appropriate intake of calories and nutrients to meet the needs of the pregnant woman and the developing embryo

and fetus. Weight-loss programs are best completed prior to conception, and pregnancy avoidance can be counseled for women who are dieting. Women who become pregnant when obese or dieting can be counseled about the risks of NTDs and perhaps other congenital anomalies, and prenatal testing for these abnormalities can be offered.

Although weight-reduction surgery may produce important health benefits associated with weight loss and appears to improve fertility in overweight women, the decision to use surgery in the treatment of obesity needs to be individualized. The Public Affairs Committee does not have a recommendation concerning the routine use of such surgery prior to pregnancy, but notes that 2 recent reports suggested that preconception gastric banding is compatible with normal pregnancy and may even lead to better pregnancy outcomes compared to those of obese women who do not have weight loss surgery (Weiner et al., 2003; Skull et al., 2004). These 2 reports are essentially case series and by themselves do not definitively answer the question of whether pregnancy risks are increased after obesity surgery. A third article, which presented a comparison of pregnancies in 298 women with previous bariatric surgery and 158,912 women without previous bariatric surgery, reported no adverse effects of surgery on pregnancy outcome, with the exception of effects attributable to residual obesity plus an additional increase in cesarean section risk (Sheiner et al., 2004b). Congenital malformations occurred in 5% of pregnancies in women who had previous bariatric surgery, and 4% of the control pregnancies. Because some weight loss procedures can result in nutritional deficiencies, it appears reasonable to recommend that pregnancy be delayed until surgery-related weight loss has stabilized (Marceau et al., 2004; ACOG Committee on Obstetric Practice, 2005). Nutritional counseling for the pregnant woman who has had bariatric surgery may be particularly important (reviewed by Woodard, 2004).

The Public Affairs Committee recommends that health-care providers educate parents about appropriate childhood nutrition. Breast-feeding should be encouraged based on evidence of a protective effect against childhood obesity (Owen et al., 2005), as well as other health advantages. Intervention may be particularly important for children born to obese mothers (Whitaker, 2004). Prevention of childhood obesity is expected to play an important role in preventing obesity during the reproductive years.

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