PREGNANCY-RELATED MORTALITY ASSOCIATED WITH OBESITY IN FLORIDA 1999 THROUGH 2002

By: Daniel Thompson, M.P.H.; Carol Graham, Ph.D.; Deborah Burch, B.S., R.N.; Angel Watson, M.P.H., R.H.I.A.; Annette Phelps, ARNP, MSN

Florida Department of Health, Division of Family Health Services
Bureau of Family and Community Health

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Abstract

In order to examine the association of obesity with maternal mortality in Florida, a matched, case-control analysis was conducted for 115 pregnancy-related deaths occurring in Florida during the years 1999 through 2002. The cases were matched to 460 controls (4 controls per case), based on maternal age, race, education, and marital status. Body mass index (BMI) was used as a measure of obesity. The results for this analysis indicated that the odds of pregnancy-related death increased significantly with increased levels of BMI. The adjusted-odds ratios ranged from 1.99 (95% CI 1.13 to 3.51) for women classified as overweight (BMI 25.0 to 29.9) to 5.12 (95% CI 2.22 to 11.78) for women classified as obese 3 (BMI of 40 or above).

Introduction

In 1996, Florida initiated the Pregnancy-Associated Mortality Review (PAMR) process to improve surveillance and analysis of pregnancy-related mortality. PAMR uses the expanded definition of maternal mortality developed by the Centers for Disease Control and Prevention (CDC), and the American College of Obstetrics and Gynecology (ACOG). This definition is: "…death of a woman, from any cause, while she is pregnant or within 1 year of termination of pregnancy, regardless of duration and site of the pregnancy." Using this definition, 143 deaths were identified as pregnancy-related in Florida in the four year period of 1999 through 2002. During this time, recurring themes from the PAMR process suggested that obesity might be associated with increased risk of pregnancy-related mortality. The purpose of this analysis is to quantify the relationship between obesity, and risk of pregnancy-related mortality in Florida.

Methods

In the PAMR process, various methods are used to identify all deaths to women of reproductive age that may be pregnancy-associated. These deaths are then reviewed by a Department of Health nurse-physician team to make an initial categorization of the death as pregnancy-related, possibly pregnancy-related, or not pregnancy-related. All of the pregnancy-related deaths, and a stratified, random sample of the possibly pregnancy-related and not pregnancy-related deaths are then reviewed by the PAMR team. The PAMR team is a multidisciplinary group of 31 professionals including physicians, nurses, nurse midwives, social workers, educators, and researchers. In the period of 1999 through 2002, 218 deaths were reviewed by the PAMR team, 143 were determined to be pregnancy-related deaths, 37 were determined to be possibly pregnancy-related, 37 were classified as not pregnancy-related, and one could not be classified. This provides a complete, or very nearly complete, enumeration of the pregnancy-related deaths.

The PAMR process also includes case abstraction and review of the case abstracts by the PAMR review team. For more information about the PAMR process, please refer to "1999–2002 Florida Pregnancy-Associated Mortality Review (PAMR)," located at the following website: http://www.doh.state.fl.us/Family/mch/docs/pdf/PAMR99-02.pdf.

The calculation of maternal mortality rates requires complete and accurate data for the number of persons who are at risk of experiencing a pregnancy-related death. The necessary denominator is all women who were pregnant within a given time period. While accurate counts are available for women who give birth and for women whose pregnancy ended in a fetal death, complete data are not available for women whose pregnancy ended in a spontaneous or induced abortion in Florida. In the absence of complete data for all pregnant women, inferences can be made by comparing pregnancy-related mortality cases to similar women who were pregnant and did not die. This is known as a case control analysis where the pregnancy-related deaths are cases, and they are matched to similar women who were pregnant during the same time period and did not die; these latter are the controls for this analysis.

Florida law requires that all pregnant women be offered the Healthy Start Prenatal Risk Screening at their first prenatal visit. While this applies to all prenatal care providers, there are some providers who do not offer the screening; in addition, the risk screening is voluntary and some women decline the screening. As a result, each year approximately half of all women who give birth are screened by Florida's Healthy Start (approximately 100,000 women). The Healthy Start Prenatal Screening records were used to obtain information on women who could be used as controls for this analysis. For each case, four prenatal screening records were

randomly selected from the time period of 1999 through 2002. These controls were matched to the cases so that each case and the four corresponding controls had the same race, marital status, age, and education. This is a method used to control for, or eliminate, the confounding effects of these variables.

Obesity was measured using the BMI which accounts for both height and weight in assessing obesity. The formula is: weight divided by the square of the height, where weight is expressed in kilograms and height is in meters. Ranges of BMI are used to classify women as shown in Table 1. For example, the BMI range of 30.0 to 34.9 is classified as "Obese 1" and the BMI range of 40 and above is classified as "Obese 3."

SAS software was used to compute the odds ratios for pregnancy-related mortality associated with six levels of BMI. Cox Proportional Hazard methods were used to perform conditional, logistic regression and obtain the adjusted-odds ratios. Instructions in the SAS manual for using the PHREG procedure to perform conditional, logistic regression were followed. The results were the same when the Epi-Info Conditional Logistic Regression procedure was used. In addition, the t test procedure was used to test for a statistically significant difference in BMI for the cases compared to the matched controls.

Results

There were 143 pregnancy-related deaths in Florida occurring in the years 1999 through 2002. For this analysis, 28 (20%) of these deaths were excluded due to missing data for height, weight, age, race, marital status, or education. The remaining 115 cases were matched to four randomly selected controls as explained in the methods section. Table 1 gives the number and percentages of cases and controls in each of the six BMI categories.

Table 1 illustrates that cases tend to have higher percentages in the higher BMI categories, compared to the controls. The results also show that while 25.2% of the cases are in the normal BMI category, a greater percentage (47.2%) of the controls is in the normal BMI category.

Table 2 shows the adjusted-odds ratios for pregnancy-related death associated with the BMI categories, using the "Normal Weight" category as the reference. All of the other BMI categories are associated with increased risk of pregnancy-related death. The odds ratio in the underweight category is marginally, statistically significant with a p value of 0.054. The odds ratios in the other BMI categories are all statistically significant with p values all well below 0.05. Additionally, the pattern follows a dose response trend with higher adjusted-odds ratios associated with the higher BMI categories.

The results of the t test on the difference in BMI for the cases compared with the matched controls showed that the difference is statistically significant. The mean difference was 3.00 (95% CI 1.50 to 4.51) with a p value of 0.0001.

Discussion

This analysis is subject to several limitations. Missing values resulted in the exclusion of 20% of the cases and if the excluded cases were substantially different from the cases in the analysis, the results could be biased. Additionally, the BMI is based on self-reported height and weight which could result in reporting bias as it is likely that people tend to under-estimate their weight. However, if the reporting bias affects both cases and controls equally, the odds ratios will be minimally affected since the biases would be equivalent for both groups in the calculations. Selection bias could also be present since controls were selected from among pregnant women who were screened with the Healthy Start prenatal risk screening. If the relationship between obesity and risk of pregnancy-related death is different for women who were not screened, then a selection bias could be present. This potential bias is at least partially eliminated, however, through the matching of cases and controls.

The adjusted-odds ratios indicate that high BMI is associated with increased risk of pregnancy-related death. Since the cases and controls were matched, these odds ratios are not influenced by differences in race, age, education, or marital status between the cases and the controls. These results provide a rationale for the development of strategies to address the reduction of high BMI before women become pregnant.

Table 1

Pregnancy-Related Deaths (Cases) and Matched Controls
FLORIDA 1999 - 2002

BMI	Category	Cases	Controls	Percent Cases	Percent Controls
< 18.5	Underweight	8	23	7.0%	5.0%
18.5 - 24.9	Normal Weight	29	217	25.2%	47.2%
25.0 - 29.9	Overweight	31	122	27.0%	26.5%
30.0 - 34.9	Obese 1	23	59	20.0%	12.8%
35.0 - 39.9	Obese 2	11	18	9.6%	3.9%
40 +	Obese 3	13	21	11.3%	4.6%
		115	460	100.0%	100.0%

Table 2

Adjusted-Odds Ratios for Pregnancy-Related Mortality Associated with Maternal Body Mass Index (BMI)) Based on Matched Case Control Data FLORIDA 1999 - 2002

BMI	Category	Adjusted-Odds Ratio	95% CI Lower Limit	95% CI Upper Limit	p Value
< 18.5	Underweight	2.47	0.99	6.17	0.054
18.5 - 24.9	Normal Weight	Referent	Referent	Referent	Referent
25.0 - 29.9	Overweight	1.99	1.13	3.51	0.017
30.0 - 34.9	Obese 1	2.99	1.61	5.55	0.001
35.0 - 39.9	Obese 2	4.71	2.00	11.08	0.000
40 +	Obese 3	5.12	2.22	11.78	0.000