# Body Mass Index, Midwifery Intrapartum Care, and Childbirth Lacerations

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Weight status is an important determinant of many health indices. Data from a clinical trial on measures to lower genital tract trauma in vaginal birth were used for a secondary analysis. The goal was to describe the relationship of body mass index and pregnancy weight gain to clinical intrapartum care, infant birthweight, and genital tract trauma with vaginal birth. Intrapartum care measures and labor events did not vary by maternal weight status. Overweight and obese women were more likely to be parous, and Hispanic or American Indian. Total pregnancy weight gain decreased, and infant birthweight increased as body mass index category increased. Obese women who gained 40 or more pounds during pregnancy had elevated rates of macrosomia and genital tract lacerations. J Midwifery Womens Health 2006;51:249–253 © 2006 by the American College of Nurse-Midwives.

keywords: body mass index, fetal macrosomia, genital tract lacerations, infant birthweight, pregnancy weight gain

### INTRODUCTION

Excess body weight and the influence of weight gain on health status are compelling public health issues in the United States. Data from representative national surveys conducted periodically since the early 1960s show that in each decade of adult life, women's body weight has risen 25 pounds on average, but height has risen only one inch.<sup>1</sup> The prevalence of overweight and obesity is greater among women of low socioeconomic status and women of racial/ethnic minorities, with Asian women being a noted exception.<sup>2,3</sup> Because midwives care for diverse patient populations, including groups with rising rates of overweight and obesity, the links between weight status and common health outcomes are of clinical relevance.

Women's overall health is influenced by body weight; a woman's risk of disease rises in proportion to the increase in body weight. Outside of pregnancy, overweight and obesity are associated with elevated rates of hypertension, diabetes, breast and endometrial cancer, gall bladder disease, and osteoarthritis.<sup>2</sup> During pregnancy and childbirth, greater body weight is associated with an elevated risk of hypertensive disorders, gestational diabetes, cesarean birth, and fetal macrosomia.<sup>4–6</sup>

Overweight and obesity are defined by the amount of excess body fat. One determinant of weight status is the body mass index (BMI), which is calculated as body weight in kilograms divided by height in meters squared.<sup>7</sup> Resulting values are grouped into categories indicating underweight, normal weight, overweight, and obesity. BMI is simple to calculate, and therefore makes a clinically useful measure. However, it has some limitations. The BMI categories do not reflect the distribution

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of excess fat accumulation ("apple" or "pear" body shape) that is associated with differences in health risks, nor do they consider the ratio of lean muscle mass to body fat, as in the case of athletes.<sup>2</sup>

BMI at the start of pregnancy exerts a major influence on infant weight at birth.<sup>8–10</sup> Fetal macrosomia (typically defined as a birthweight of  $\geq 4000$  grams) may partially explain the elevated rates of cesarean delivery in overweight and obese women. Fetal macrosomia may also be linked with other birth complications, such as a prolonged second stage of labor, shoulder dystocia, surgical complications, operative vaginal delivery procedures, and lacerations of the genital tract.

Although women who are overweight or obese face an elevated risk of health problems during pregnancy and with birth, not all will be negatively affected. Many women with an elevated BMI will have a completely normal maternity experience, and the extent to which the style of care may influence a normal outcome is not known. A large clinical trial at the University of New Mexico Health Sciences Center allowed an opportunity to examine the relationship of BMI at the start of pregnancy with clinical care in childbirth, infant birthweight, and genital tract lacerations with vaginal birth. The focus of this analysis was to describe any variations in care and outcomes according to maternal BMI and total pregnancy weight gain.

#### METHODS

Data from a randomized trial of perineal management techniques were used for this article.<sup>11</sup> The study was carried out at the University of New Mexico Health Sciences Center between 2001 and 2005. Healthy women in midwifery care were recruited prenatally and provided informed consent in either English or Spanish. Healthy gravidas were randomized in labor to one of three perineal management strategies for the second stage: 1) warm compresses to the perineum; 2) massage with

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lubricant; or 3) hands kept off the perineum until crowning of the infant's head. The goal of the trial was to systematically compare perineal management methods to determine if any was associated with fewer spontaneous lacerations of the genital tract in vaginal birth. A complete discussion of all study variables and the research methodology is found in the primary results paper.<sup>11</sup>

The research protocol and consent forms for the clinical trial were approved by the local institutional review board (Human Research Review Committee [HRRC]) and also by the National Indian Health Service Institutional Review Board. This report is based on a secondary analysis of the database, which retained no personal identifiers. HRRC approval has been maintained, by yearly review, until all papers from the dataset are published.

Over a 38-month period, 1211 women participated in the clinical trial, and a staff midwife performed the randomly allocated perineal technique prior to the birth. Data collection occurred after each study birth and involved a complete assessment of all childbirth lacerations (whether sutured or not), and the recording of other data items, including maternal demographics, elements of clinical intrapartum care, and specified birth outcomes. It should be noted that episiotomies are rarely performed by any clinicians (midwives, obstetricians, and family physicians) at the study site, and that the rate is under 1% for all provider groups.

The analysis group for this report consisted of women who had a spontaneous vaginal birth without an episiotomy, and who self-reported data after their delivery for height, prepregnancy weight, and total weight gain during pregnancy. Exclusions were 25 operative deliveries (9 cesareans, 3 forceps, and 13 vacuum) and 10 births with an episiotomy. Of 1176 women with a spontaneous vaginal birth and no episiotomy, nine had missing data for height or prepregnancy weight, so BMI could not be calculated. Three additional women had missing data for total weight gain during pregnancy. This left 1164 women with complete data for this report, and 1167 women with BMI but not total weight gain data. The SAS system<sup>12</sup> was used on a mainframe computer for all analyses.

BMI was calculated from the data reported by mothers on height and prepregnancy weight, and these values were rounded to the nearest whole number. Women were then placed into discrete BMI categories, with underweight defined as a BMI < 20, average as 20–24, overweight as 25–29, and obese as  $\geq$  30. Descriptive data are reported for maternal characteristics and intrapartum care variables according to BMI category. Statistical significance for differences in proportions was assessed by the  $\chi^2$  test for homogeneity of proportions. The change in proportions across BMI category was assessed by the Cochran-Armitage linear trend test, which examines changes across levels of an ordinal variable within contingency tables to evaluate patterns in the data.<sup>12</sup>

Statistical significance was set at P < .01 because of the number of comparisons made. Perineal outcomes and infant birthweight were also described by BMI category and according to total weight gain in pregnancy (< 40 lbs or  $\ge 40$  lbs).

# RESULTS

Data for women who had normal vaginal births with midwives are shown in Table 1. Nearly half were overweight or obese at the start of their pregnancy. Higher proportions of overweight and obesity are apparent in parous women and in Hispanic and American Indian women. Intrapartum care measures (epidurals, oxytocin, Valsalva pushing, delivery position, and birth of the infant's head between contractions) and labor events (terminal fetal bradycardia, prolonged second stage, infant head position at birth, and compound presentation) showed no statistically significant trends according to BMI category. Only four variables showed significant trends across BMI categories (all P < .001). Three variables showed declining proportions as BMI category increased: 1) first births versus parous women; 2) non-Hispanic white women versus Hispanic or American Indian women; and 3) those who gained  $\geq 40$ pounds versus those who gained < 40 pounds during pregnancy. The proportion of infants with a birthweight of  $\geq$  4000 grams rose significantly as BMI category increased, compared with infants weighing < 4000grams.

Tables 2 and 3 show data for childbirth lacerations and infant birthweight by prepregnant BMI category in women who reported a gain of  $\geq 40$  pounds in pregnancy (Table 2) or < 40 pounds gained (Table 3). Obese women (prepregnant BMI  $\geq 30$ ) who gained  $\geq 40$ pounds experienced perineal and vaginal trauma more frequently than did obese women who gained < 40 pounds (both P < .01). The experience of overweight women (prepregnant BMI 25–29) was not significantly different from normal weight women, and excess pregnancy weight gain was not associated with significantly higher rates of perineal or vaginal trauma in this group. Fetal macrosomia increased according to BMI category,

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	Table 1	. Dem	ographic	and	Clinical	Variables	by	Body	Mass	Index	(BMI)	Grou	p*
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	Underweight BMI < 20 $(n = 132)$	Average BMI 20–24 (n = 469)	Overweight BMI 25–29 $(n = 342)$	Obese BMI $\geq$ 30 (n = 224)
Parity				
First birth†	65 (49.2)	206 (43.9)	112 (32.7)	66 (29.5)
Second birth	43 (32.6)	165 (35.2)	121 (35.4)	86 (38.4)
Third birth or higher	24 (18.2)	98 (20.9)	109 (31.9)	72 (32.1)
Maternal age, $\geq 30$ y	16 (12.1)	74 (15.8)	74 (21.6)	38 (17.0)
Maternal education, $<$ high school	93 (71.0)	294 (63.0)	222 (64.9)	155 (69.5)
Race/ethnicity				
Hispanic	53 (40.2)	216 (46.1)	185 (54.1)	104 (46.4)
Non-Hispanic white†	60 (45.5)	177 (37.7)	88 (25.7)	55 (24.6)
American Indian	8 (6.1)	50 (10.7)	55 (16.1)	55 (24.6)
Other	11 (8.2)	26 (5.5)	14 (4.1)	10 (4.4)
Weight gain, $\geq$ 40 lbs <sup>†</sup>	44 (33.3)	137 (29.3)	82 (24.0)	39 (17.6)
Intrapartum clinical factors				
Epidural analgesia	48 (36.4)	170 (36.3)	122 (35.7)	79 (35.3)
Oxytocin infusion	38 (28.8)	152 (32.4)	117 (34.2)	86 (38.4)
Valsalva pushing	24 (18.2)	88 (18.8)	79 (23.1)	41 (18.3)
Terminal fetal bradycardia	8 (6.1)	51 (10.9)	35 (10.2)	23 (10.3)
Sitting for delivery (45° or more	120 (90.9)	373 (79.5)	273 (79.8)	191 (85.3)
from horizontal)				
Prolonged second stage <sup>‡</sup>	5 (3.8)	19 (4.1)	16 (4.7)	7 (3.1)
Head delivered between contractions	41 (31.1)	169 (36.0)	109 (31.9)	73 (32.6)
Head delivered occiput anterior position	128 (97.0)	439 (93.6)	325 (95.0)	214 (95.5)
Compound presentation	19 (14.4)	61 (13.0)	40 (11.7)	12 (5.4)
Birthweight $\geq$ 4000 g†	5 (3.8)	23 (4.9)	31 (9.1)	33 (14.7)

\*All values reported as n (%).

<sup>+</sup>Trends across categories of BMI are statistically significant (P < .001).

 $^{*}>$  2.5 hours for nulliparas, and > 1 hour for multiparas.

and the increase was most pronounced for obese women who gained  $\geq 40$  pounds (P < .001).

#### DISCUSSION

This report assessed variations in midwifery intrapartum care and two specific outcomes (fetal macrosomia and genital tract trauma) according to maternal BMI immediately prior to pregnancy and total weight gain during pregnancy. Obese women who gained excess weight in pregnancy had elevated rates of fetal macrosomia and genital tract trauma with vaginal birth. Thus, higher maternal weight was associated with an increased number of childbirth lacerations, even though these women were healthy throughout pregnancy and during labor, and all had normal vaginal births with midwives.

Some limitations should be noted. Because all women in this dataset were healthy, these data would not apply to other obstetric populations, where higher rates of medical problems (hypertension, diabetes) and obstetric complications (cesarean delivery, vaginal operative procedures)

Underweight BMI < 20 (n = 44)	Average BMI 20–24 (n = 137)	Overweight BMI 25–29 $(n = 82)$	Obese BMI $\geq$ 30 (n = 39)
8 (18.2)	23 (16.8)	23 (28.1)	3 (7.7)
17 (38.6)	58 (42.3)	34 (41.4)	22 (56.4)
17 (38.6)	57 (37.2)	34 (41.4)	20 (51.3)
21 (47.7)	70 (51.1)	36 (43.9)	19 (48.7)
6 (13.6)	23 (16.8)	12 (14.6)	10 (25.6)
3 (6.8)	7 (5.1)	6 (7.3)	1 (2.6)
3 (6.8)	14 (10.2)	9 (11.0)	12 (30.8)
	Underweight BMI < 20 (n = 44) 8 (18.2) 17 (38.6) 17 (38.6) 21 (47.7) 6 (13.6) 3 (6.8) 3 (6.8)	Underweight BMI < 20 (n = 44)Average BMI 20–24 (n = 137) $8 (18.2)$ $23 (16.8)$ $17 (38.6)$ $58 (42.3)$ $17 (38.6)$ $57 (37.2)$ $21 (47.7)$ $70 (51.1)$ $6 (13.6)$ $23 (16.8)$ $3 (6.8)$ $7 (5.1)$ $3 (6.8)$ $14 (10.2)$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

Table 2. P	erineal Outcomes	and Birthweight by	Body Mas	s Index (BMI	I) Group for Wome	en Who Gained $\geq$ 40	pounds in Pregnancy	$(N = 302)^{4}$
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\*All values reported as n (%).

<sup>†</sup>Twenty-three percent of study participants had first degree trauma, 18% had second degree trauma, and 1% had a third or fourth degree laceration, so all perineal lacerations were collapsed into a single "perineal" category.

Table 3.	Perineal Outco	mes and Birthy	veight by Body	Mass Index	(BMI) Group t	for Women Who	Gained $< 40$	) Pounds in Pregnanc	$y (N = 862)^*$
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	Underweight BMI < 20 (n = 88)	Average BMI 20–24 (n = 331)	Overweight BMI 25–29 (n = 260)	Obese BMI $\geq$ 30 (n = 183)
No trauma	21 (23.8)	68 (20.5)	69 (26.5)	50 (27.3)
Perineal <sup>†</sup>	37 (42.0)	151 (45.6)	99 (38.1)	64 (35.0)
Vaginal	33 (37.5)	141 (42.6)	100 (38.5)	65 (35.5)
Labial	55 (62.5)	168 (50.8)	129 (49.6)	75 (41.0)
Periurethral	14 (15.9)	34 (10.3)	30 (11.5)	20 (10.9)
Clitoral	4 (4.6)	13 (3.9)	7 (2.7)	7 (3.8)
Birthweight $\geq$ 4000 g	2 (2.3)	9 (2.7)	22 (8.5)	19 (10.4)

\*All values reported as n (%).

<sup>†</sup>Twenty-three percent of study participants had first degree trauma, 18% had second degree trauma, and 1% had a third or fourth degree laceration, so all perineal lacerations were collapsed into a single "perineal" category.

are present, especially in overweight and obese women. It is therefore possible that these data may be biased toward normal weight women, if many overweight and obese women were screened out of the original clinical trial because of medical problems.

In addition, BMI for this study was calculated from self-reported prepregnancy height and weight values. If women systematically underreported their prepregnancy weight, then true BMI values would be underestimated to some degree. Ideal BMI values would come from anthropomorphic measurements made just prior to pregnancy, but this was not realistic in our clinical setting. Measurements taken at the beginning of pregnancy would have varied according to the timing of prenatal care onset, and one-third of our clients begin their prenatal care after the first trimester. Maternal self-report was felt to yield the most useful estimates for BMI determination.

Our results indicate that clinical care measures (epidurals, oxytocin, Valsalva pushing, delivery position, and birth of the infant's head between contractions) and common labor events (terminal fetal bradycardia, prolonged second stage, infant head position at birth, and compound presentation) showed no significant trends according to maternal BMI category. This suggests that important elements of intrapartum care were not biased by maternal weight status. It also suggests that common events in normal labor probably do not vary in any important way according to maternal BMI.

Fetal macrosomia increased across BMI category, and was most prevalent in the infants of obese women. This is consistent with other reports showing that prepregnancy BMI is a primary determinant of ultimate infant size.<sup>8–10</sup> The downward trend of excess maternal weight gain across BMI category (Table 1) is in accord with recommendations from the Institute of Medicine<sup>4</sup> and the American College of Obstetricians and Gynecologists.<sup>13</sup> The obese women who gained less weight had smaller infants and less genital tract trauma than those who gained  $\geq$  40 pounds.

The clinical literature contains conflicting reports concerning the association of increased BMI with third- and fourth-degree perineal lacerations.<sup>9,10</sup> Results are difficult to interpret because of the lack of control for episiotomy and operative vaginal procedures for birth, both of which are known risk factors for severe perineal injury. Our data showed that healthy, obese women who gained excess weight during pregnancy were at greater risk of genital tract trauma, even in the absence of episiotomy and operative vaginal birth, although thirdand fourth-degree lacerations were still rare (1% for the dataset). Fetal macrosomia, a key factor in the etiology of spontaneous lacerations with normal vaginal birth,<sup>11</sup> is presumed to be one explanatory factor. A larger dataset would permit multivariate analyses to clarify the association of BMI with third- and fourth-degree lacerations.

Several features of the data are consistent with published literature.<sup>2,3</sup> For example, higher rates of overweight and obesity were observed in Hispanic women (52%) and American Indian women (66%), compared to non-Hispanic white women (38%). Increased rates of overweight and obesity were also observed in parous women. In first-time mothers, the rate was 40%; with the second birth, 50%; and with a third or subsequent birth, 60%. This indicates that these groups warrant focused and culturally-appropriate diet and activity counseling before, during, and after each pregnancy, to mitigate the cycle of increasing BMI with repeat pregnancies.

Addressing nutrition, exercise, and weight gain with women, whether in or out of pregnancy, is a difficult and sometimes frustrating challenge for clinicians. However, these are key factors contributing to overall well being and a reduction of the lifetime burden of chronic disease. Our data show that high BMI at the start of pregnancy, plus excess weight gain during pregnancy, are linked with higher rates of macrosomia and genital tract lacerations. More prospective studies of behavioral and counselling interventions are needed to identify promising strategies to prevent excessive pregnancy weight gain and postpartum weight retention. Creative, sensitive, and continuing attention to maternal weight issues would improve the health of new mothers. This work was supported by grant 1 R01 NR05252-01A1 from the National Institutes of Health/National Institute of Nursing Research (PI, Albers). The midwives at the University of New Mexico Health Sciences Center conducted primary data collection in the clinical trial: Ginie Capan, Ellen Craig, Kelly Gallagher, Betsy Greulich, Martha Kayne, Robyn Lawton, Regina Manocchio, Laura Migliaccio, Deborah Radcliffe, Martha Rode, Dympna Ryan, Kay Sedler, and Beth Tarrant.

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