

The 'skinny' on low maternal weight and adverse pregnancy and infant outcomes



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MCH Concern

- In an increasingly weight-conscious society, constantly bombarded by media images of skinny models, many young women strive to be 'thin.' Eating disorders such as anorexia and bulimia are increasing among young women in their 20's and 30's.¹
- Underweight women may suffer from improper nutrition, anemia, and other conditions. When pregnant, this may result in an inability to sustain an adequate intrauterine environment for a developing fetus.
- Although outcomes among obese women have been well studied, possible adverse pregnancy outcomes among underweight women are not well understood.
- Low birth weight (<2500 g) and preterm delivery (<37 weeks gestation) contribute significantly to infant mortality rates and are associated with life-long disabilities, such as mental retardation, cerebral palsy, and other developmental problems.²
- We compared the occurrence of adverse birth outcomes among women with low (<18.5) and normal (20.01-24.99) body mass index (BMI).

Approach

- Population-based cohort study among women with singleton live births
- Washington State linked birth-hospital discharge data for 2001-2004

BMI measurement in the birth certificates:

- 2001-2002: Pre-pregnancy weight variable on the birth record, plus height information supplied by linkage to Washington State Drivers' License Records
- 2003-2004: Pre-pregnancy weight + height variables, both from birth record
- BMI = $\frac{[\text{Pre-pregnancy weight (lbs.)}] \cdot (703.7)}{\text{Height (inches)}^2}$

Subjects:

- Underweight women = all 7,911 women with pre-pregnancy BMI <18.5
- "Normal" weight comparison group = 39,555 randomly selected women with BMI = 20.01-24.99, frequency matched by delivery year.

Analysis

- Mantel-Haenszel stratified analysis to estimate relative risks (RR) and 95% confidence intervals (CI) of selected pregnancy and infant outcomes.
- Pregnancy outcomes assessed: preterm (<37 weeks) or post-term (41+ weeks) delivery, primary Cesarean section, and premature rupture of the membrane (PROM) before or after 37 weeks gestation.
- Infant outcomes assessed: birth weight <2,500 or 4,000+ grams, size for gestational age, infant death <12 months, congenital malformations, and infant anemia
- Variables considered for their potential effects in these relationships: mother's age, number of prior births, marital status, mother's education, mother's race/ethnicity, insurance, participation in Women, Infants and Children (WIC) program for low income families, trimester prenatal care began, prenatal smoking and alcohol use, maternal anemia, and maternal anorexia. All risk estimates were adjusted for maternal age and delivery year (unless otherwise noted).

Table 1. Characteristics of mothers with low (<18.5) and normal (20.01-24.99) body mass index (BMI) who had singleton live births in Washington State, 2001-2004.^a

Characteristic	BMI		Low (N=7911) %	Normal (N=39555) %
	Low (N=7911)	Normal (N=39555)		
Age (years)				
<18	5	3		
18-24	43	30		
25-34	44	52		
35+	8	16		
Ethnicity				
White	67	76		
Black	3	3		
Other	28	19		
Number of Prior Births				
0	52	45		
1	30	33		
2 or more	18	22		
Marital Status				
Married	64	74		
Unmarried	36	26		
Education				
<12 years	22	14		
H.S. Diploma/GED	29	24		
Some College/BA	78	47		
Master's/Doctorate	8	12		
Smoking				
No	81	89		
Yes	18	10		
Drinking				
No	95	97		
Yes	5	3		
Insurance				
Medicare/Medicaid	46	57		
Other	54	43		
WIC Program				
Yes	51	63		
No	43	31		
Trimester Prenatal Care Began				
1 st	73	79		
2 nd	15	12		
3 rd or None	3	2		

^aNumbers may not add to total because of missing data

Table 2: Selected adverse pregnancy and infant outcomes in mothers with low (<18.5) and normal (20.01-24.99) body mass index (BMI) with singleton live births in Washington State, 2001-2004.

Outcome	Low (N=7911)		Normal (N=39,555)		RR	95% CI
	n/total	%	n/total	%		
Pregnancy outcomes						
C-section ^{1,2}	668/4,072	16.4	3,943/17,722	22.2	0.81	0.75, 0.87
Gestational age at delivery						
< 37 weeks ²	663/7,864	8.4	2,424/39,351	6.2	1.30	1.20, 1.41
37-40 weeks	6,429/7,864	81.8	32,197/39,351	81.8	1.00	ref
41+ weeks ²	772/7,864	9.8	4,730/39,351	12.0	0.83	0.77, 0.89
Premature Rupture of Membranes (PROM) ³						
No	7,361/7,631	96.5	36,954/38,286	96.5	1.00	ref
<37 weeks ²	85/7,631	1.1	315/38,286	0.8	1.35	1.06, 1.72
37+ weeks ²	185/7,631	2.4	1,017/38,286	2.7	0.91	0.78, 1.06
Infant outcomes						
Birth Weight in Infant						
<2,500 g ³	584/7,889	7.4	1,571/39,473	4.0	1.62	1.47, 1.77
2500-4000 g	6,908/7,889	87.6	33,615/39,473	85.2	1.00	ref
>4000 g ²	397/7,889	5.0	4,287/39,473	10.9	0.52	0.47, 0.57
Infant death (<1 year old) ²	28/7,650	<0.1	117/38,474	<0.1	1.09	0.72, 1.64
Any Congenital Malformations	108/7,650	1.4	604/38,474	1.6	0.87	0.71, 1.07
Anemia in Infant ²	6/7,650	<0.1	16/38,474	<0.1	1.72	0.69, 4.24
Size for Gestational Age						
Small ³	1,217/7,866	15.5	3,361/39,379	8.5	1.62	1.52, 1.72
Normal	6,362/7,866	80.9	32,876/39,379	83.5	1.00	ref
Large ²	287/7,866	3.6	3,142/39,379	8.0	0.52	0.47, 0.59

¹ C-section among women with no prior births.

² Adjusted for mother's age and delivery year

³ Adjusted for mother's age, smoking and delivery year

Findings

Underweight women were at a greater risk for:

- Preterm delivery <37 weeks (RR = 1.30, 95% CI 1.20, 1.41)
- Having a low birth weight infant <2500 g. (RR = 1.62, 95% CI 1.47, 1.77)
- Experiencing preterm PROM (RR = 1.35, 95% CI 1.06, 1.72)
- Having a small for gestational age infant (RR = 1.62, 95% CI 1.52, 1.72)

Underweight women had a reduced risk of C-section (RR = 0.81, 95% CI 0.75, 0.87)

There was no increased occurrence of infant death, malformations, or anemia among infants of underweight women, relative to those of normal weight women.

Limitations

- Our study only included live births. Women with low BMI may have a greater risk of miscarriage, which we were unable to measure. To the extent that such a risk is associated with presence of malformations, we may have underestimated the RR for malformations.
- Women may not have accurately self-reported their weight in the records used to abstract birth certificate information. It is likely the most severe cases of low BMI will not be misclassified by a woman's inaccurate report of her weight, however, women whose BMI falls close to the cut-off between low and normal BMI could be misclassified. Because of this, our exposed/non-exposed groups excluded women who fell along the cut-off between low and normal BMI (18.6-20.0).
- Some studies have suggested that children of underweight women may have developmental delays observed in childhood. We were unable to assess longer term effects on infants such as brain development or intelligence.

Implications

- Low maternal pre-pregnancy weight may be associated with potentially serious outcomes including low birth weight, preterm delivery, a small for gestational age infant, and preterm PROM. This suggests fetal growth may be decelerated in pregnant underweight women, and the possibility that undernourishment (or other features associated with being underweight) may make it difficult to maintain pregnancy to full term.
- Infant death and malformations were not increased, suggesting that any effects of low maternal weight were not associated with outcomes beyond delivery, or with development of fetal organ systems as measured using birth certificates.
- Prevention of preterm delivery and low birth weight may save nearly \$60,000 in medical expenses during an infant's first year.² Proper nutritional counseling for underweight women of childbearing age may be a useful public health measure to help reduce these serious outcomes.

References:

- Pawluck DE, Gorey KM. Secular trends in the incidence of anorexia nervosa: integrative review of population based studies. *Int. J. Eating Disorders*. 1998; 23(4):347-512.
 - U.S. Department of Health & Human Services. Progress Review: Maternal, Infant, and Child Health. *Healthy People 2010*. October 22, 2003.
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