PREPREGNANCY WEIGHT AND THE RISK OF ADVERSE PREGNANCY OUTCOMES

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ABSTRACT

Background Obesity before pregnancy is associated with an increased risk of several adverse outcomes of pregnancy. The risk profiles among lean, normal, or mildly overweight women are not, however, well established.

Methods We studied the associations between prepregnancy body-mass index (defined as the weight in kilograms divided by the square of the height in meters) and the frequency of late fetal death, early neonatal death, preterm delivery, and delivery of a small-for-gestational-age infant in a population-based cohort of 167,750 women in Sweden in 1992 and 1993. The women were categorized as follows, according to body-mass index: lean, less than 20.0; normal, 20.0 through 24.9; overweight, 25.0 through 29.9; and obese, 30.0 or more. The estimates were adjusted for maternal age, parity, smoking, education, whether the mother was living with the father, and maternal height.

Results Among nulliparous women, the odds ratios for late fetal death were increased among women with higher body-mass indexes as compared with lean women, as follows: normal women, 2.2 (95 percent confidence interval, 1.2 to 4.1); overweight women, 3.2 (95 percent confidence interval, 1.6 to 6.2); and obese women, 4.3 (95 percent confidence interval, 2.0 to 9.3). Among parous women, only obese women had a significant increase in the risk of late fetal death (odds ratio, 2.0; 95 percent confidence interval, 1.2 to 3.3). Among nulliparous women, the risk of very preterm delivery (at ⩽32 weeks' gestation) was significantly increased among obese as compared with lean women (odds ratio, 1.6; 95 percent confidence interval, 1.1 to 2.3), whereas among parous women, the risk was highest among those who were lean. The risk of delivering a small-for-gestational-age infant decreased more with increasing body-mass index among parous than among nulliparous women.

Conclusions Higher maternal weight before pregnancy increases the risk of late fetal death, although it protects against the delivery of a small-for-gestational-age infant. (N Engl J Med 1998;338:147-52.)

OBESITY before pregnancy is associated with an increased risk of fetal macrosomia and perinatal mortality.[1-3] The mother's being leaner than average (underweight), on the other hand, is associated with an increased risk of delivering an infant who is small for gestational age and perhaps also the risk of preterm delivery.[3-6] Pregnancies among underweight or overweight women are therefore often regarded as high-risk pregnancies, and thin women are frequently advised to gain weight before becoming pregnant.[7,8] Nonetheless, the optimal weight or body-mass index for women who wish to become pregnant is not known.[7-9]

The Swedish Medical Birth Register covers virtually all births in Sweden and includes prospectively collected data on maternal characteristics and complications during pregnancy, delivery, and the neonatal period. Using this data set, and adjusting for potentially confounding factors, we studied the effect of the prepregnancy body-mass index (defined as the weight in kilograms divided by the square of the height in meters) on the risk of late fetal death, early neonatal death, preterm delivery, and delivery of an infant who was small for gestational age.

METHODS

For the years 1992 and 1993, the birth register recorded the births of 204,555 singleton infants to women who were themselves born in Sweden, Denmark, Norway, Finland, or Iceland. The final study population included 167,750 women for whom information on prepregnancy body-mass index was available.

In Sweden, maternal characteristics are recorded in a standardized manner at the first visit for antenatal care, which occurs before the 15th week of gestation in more than 95 percent of the pregnancies. Maternal height and prepregnancy weight are recorded by recall in centimeters and kilograms, respectively, and used to calculate the prepregnancy body-mass index. We used the body-mass index to characterize women as lean (body-mass index, less than 20.0), normal (20.0 through 24.9), overweight (25.0 through 29.9), or obese (30.0 or more). Maternal smoking was categorized as no daily smoking, 1 to 9 cigarettes per day, or 10 or more cigarettes per day. Also recorded was whether the woman was living with the father. Information on the mother's years of formal education was obtained through linkage to another population-based register. Total maternal weight gain during pregnancy was recorded on admission to the delivery ward. Weight gain per completed week of gestation was calculated and used in this analysis.

Information about maternal age, parity, and complications during pregnancy or delivery was obtained from records routinely filled out when the woman was discharged from the hospital. Maternal age was defined as age in completed years at the time of delivery, and parity as the number of previous births, including stillbirths at 28 weeks of gestation or later. Complications during

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pregnancy and delivery were classified by a physician at the time of hospital discharge, according to the Swedish version of the *International Classification of Diseases, Ninth Revision* (ICD-9).[10] For this analysis, we used two groups of diagnoses associated with prepregnancy body-mass index and the risk of adverse pregnancy outcomes[2,3]: hypertensive diseases, defined as essential hypertension, preeclampsia, and eclampsia (ICD-9 codes 642A, 642E, 642F, and 642G), and diabetes mellitus, defined as insulin-dependent or non-insulin-dependent diabetes mellitus present before pregnancy or gestational diabetes (ICD-9 codes 250, 648A, and 648W).

Information about late fetal death, the duration of gestation, birth weight, and the infant's sex was obtained from the standardized pediatric record, routinely filled out immediately after delivery. Information about early neonatal deaths was obtained through linkage of individual records to the population-based Cause of Death Register. Late fetal death was defined as stillbirth occurring at 28 or more completed weeks of gestation, and early neonatal death as death occurring during the first week after birth. Preterm delivery (i.e., delivery at less than 37 completed weeks of gestation) was classified as very preterm (≤32 weeks) or moderately preterm (33 to 36 weeks). Small-for-gestational-age infants were defined as those with birth weights more than 2 SD below the mean birth weight for gestational age, according to a Swedish reference curve.[11] Estimated gestational age was based on ultrasound examinations performed routinely at no later than 18 completed weeks of gestation.

Statistical Analysis

We used multiple logistic-regression analysis to evaluate the association between prepregnancy body-mass index and late fetal death, early neonatal death, preterm delivery, and delivery of a small-for-gestational-age infant. The estimates were adjusted for maternal age, parity, education, smoking, height, whether the mother was living with the father, and weight gain during pregnancy. We excluded from our analyses women who had missing information on covariates.

Because information on weight gain during pregnancy was missing for 45 percent of the women, we performed a detailed analysis of the effects of adjustment for this variable. Three different models were estimated for each dependent variable. The first was based on the complete data set, without adjustment for weight gain; the second, on the women for whom data on weight gain were available, but without adjustment for weight gain; and the third, on the women with data on weight gain and with adjustment for weight gain. Thus, it was possible to determine whether the inclusion of weight gain in the model altered the effect of body-mass index and whether this alteration was due to changes in the subgroup analyzed or to genuine confounding.

Interactions between body-mass index and parity were assessed by means of a likelihood-ratio test comparing a base-line multivariate model without interaction terms to a model that included terms for the interaction between parity and body-mass index. To facilitate the interpretations of the effects of body-mass index, estimates are presented separately for parous and nulliparous women. Odds ratios were calculated to approximate relative risk and are presented with 95 percent confidence intervals.

RESULTS

The risk of late fetal death increased consistently with increasing prepregnancy body-mass index in the univariate analyses (Table 1). As compared with lean women, overweight and obese women had significantly increased odds ratios for late fetal death. The rates of late fetal death were 1.7 per 1000 among women for whom information about weight gain during pregnancy was available and 4.1 per 1000 among those for whom it was missing ($P<0.001$); the corresponding rates of early neonatal death were 1.1 and 2.7 per 1000, respectively ($P<0.001$). When data on weight gain during pregnancy were available, this factor did not influence the risk of late fetal death. Low weight gain (<0.25 kg per week of gestation) was associated with a marginally significant increase in the risk of early neonatal death (Table 1).

In preliminary multivariate analyses, we found no evidence of confounding of the effect of body-mass index by weight gain during pregnancy. This was true with respect to the adverse outcomes of late fetal death, early neonatal death, and preterm delivery, for which weight gain had little explanatory power, but also with respect to the delivery of a small-for-gestational-age infant, for which weight gain was an important explanatory variable. Detailed results for the delivery of a small-for-gestational-age infant are shown in Table 2. After adjustment for weight gain during pregnancy, the effects of body-mass index before pregnancy were unaltered despite the strong association between weight gain and the risk of delivering a small-for-gestational-age infant. This finding may be explained by the lack of correlation between prepregnancy body-mass index and weight gain during pregnancy. On the basis of these results, and in order to increase the precision of our analyses, we excluded weight gain during pregnancy from subsequent models.

The risk of late fetal death consistently increased with greater prepregnancy body-mass index (Table 3). As compared with lean women, women with a normal body-mass index and overweight women were at decreased risk of preterm delivery.

Obese women were more likely than lean women to have 11 years of formal education or less (75 percent vs. 56 percent), to be daily smokers (28 percent vs. 24 percent), and to have diabetes mellitus present before pregnancy or gestational diabetes mellitus (1.1 percent vs. 0.3 percent). The rate of preeclampsia increased with increasing body-mass index, as follows: lean women, 1.8 percent; normal women, 2.5 percent; overweight women, 4.2 percent; and obese women, 7.0 percent. Hypertensive disease was more common among nulliparous women (4.6 percent) than among parous women (1.9 percent) and was a major risk factor for adverse pregnancy outcomes (data not shown). On the basis of these patterns, we explored possible interactions between body-mass index and parity with respect to adverse pregnancy outcome.

Among nulliparous women, the risk of late fetal death was roughly doubled among women with a normal body-mass index, as compared with lean women, tripled among those who were overweight, and quadrupled among those who were obese (Table 4). Among the parous women, the risk of late fetal death was significantly increased only among

TABLE 1. CHARACTERISTICS OF WOMEN DELIVERING SINGLETON INFANTS IN 1992 AND 1993 IN SWEDEN AND UNIVARIATE ASSOCIATIONS WITH THE RISK OF LATE FETAL DEATH AND EARLY NEONATAL DEATH.*

CHARACTERISTIC	NO. OF BIRTHS (N=167,750)	LATE FETAL DEATH		EARLY NEONATAL DEATH	
		NO. OF CASES (N=466)	ODDS RATIO (95% CI)	NO. OF CASES (N=309)	ODDS RATIO (95% CI)
Prepregnancy body-mass index					
≤19.9†	22,634	46	1.0	36	1.0
20.0–24.9	101,266	257	1.2 (0.9–1.7)	184	1.1 (0.8–1.6)
25.0–29.9	33,438	109	1.6 (1.1–2.3)	69	1.3 (0.9–1.9)
≥30.0	10,412	54	2.6 (1.7–3.8)	20	1.2 (0.7–2.1)
Weight gain (kg/wk)					
<0.25	15,639	34	1.2 (0.7–1.9)	26	1.8 (1.0–3.4)
0.25–0.34	30,116	55	1.0 (0.7–1.6)	34	1.3 (0.7–2.2)
0.35–0.44	26,891	33	0.7 (0.4–1.1)	25	1.0 (0.6–1.9)
≥0.45†	18,838	34	1.0	17	1.0
Data missing	76,266	310	—	207	—
Age (yr)					
≤19	3,777	10	1.1 (0.6–2.1)	6	0.8 (0.4–2.0)
20–24†	34,120	82	1.0	64	1.0
25–29	66,867	167	1.0 (0.8–1.4)	102	0.8 (0.6–1.1)
30–34	43,406	124	1.2 (0.9–1.6)	83	1.0 (0.7–1.4)
≥35	19,580	83	1.8 (1.3–2.4)	54	1.5 (1.0–2.1)
Parity					
0	68,067	205	1.2 (1.0–1.4)	122	1.0 (0.8–1.2)
≥1†	99,683	261	1.0	187	1.0
Education (yr)					
≤11†	98,002	283	1.0	188	1.0
≥12	68,482	182	1.0 (0.8–1.2)	121	1.0 (0.8–1.2)
Data missing	1,266	1	—	0	—
Cigarette smoking					
None†	126,385	320	1.0	222	1.0
1–9 cigarettes/day	22,700	75	1.3 (1.0–1.7)	46	1.2 (0.8–1.6)
≥10 cigarettes/day	14,265	62	1.7 (1.3–2.3)	33	1.3 (0.9–1.9)
Data missing	4,400	9	—	8	—
Living with the baby's father					
Yes†	147,740	400	1.0	267	1.0
No	7,573	27	1.3 (0.9–1.9)	15	1.1 (0.7–1.8)
Data missing	12,437	39	—	27	—
Height (cm)					
≤154	2,977	14	1.5 (0.9–2.7)	10	1.6 (0.8–3.1)
155–159	13,898	42	1.0 (0.7–1.4)	29	1.0 (0.7–1.5)
160–164†	43,500	134	1.0	90	1.0
165–169	52,725	127	0.8 (0.6–1.0)	92	0.8 (0.6–1.1)
≥170	54,650	149	0.9 (0.7–1.1)	88	0.8 (0.6–1.1)

*CI denotes confidence interval. For early neonatal death, values are based on live births.

†The women with this characteristic served as the reference group.

the obese women. For early neonatal death, the risk among the nulliparous women was lowest among lean women and was approximately twice as high among women with higher body-mass indexes. Among the parous women, body-mass index did not influence the risk of early neonatal death.

Among nulliparous women, the risk of very preterm delivery (at ≤32 weeks of gestation) was significantly increased for obese women, whereas body-mass index did not significantly influence the risk of moderately preterm delivery (at 33 to 36 weeks) (Table 5). In contrast, among parous women, the risks of very preterm and moderately preterm delivery were lower among normal and overweight women than among lean women. The risk of delivering an infant who was small for gestational age was highest among both the lean nulliparous women and the lean parous women (Table 5), although the decrease in the risk of delivering a small-for-gestational-age infant with increasing body-mass index was greater among the parous women.

The rate of hypertensive disease among nulliparous women consistently increased with body-mass index, from 2.8 percent among the lean women to 10.2 percent among the obese women. Excluding women with hypertensive diseases did not lower the risk of late fetal death associated with increasing body-mass index, whereas the risk of very preterm

TABLE 2. ADJUSTED ODDS RATIOS FOR THE DELIVERY OF A SMALL-FOR-GESTATIONAL-AGE INFANT ASSOCIATED WITH PREPREGNANCY BODY-MASS INDEX AND WEIGHT GAIN DURING PREGNANCY AMONG WOMEN DELIVERING LIVE SINGLETON INFANTS IN SWEDEN IN 1992 AND 1993.*

VARIABLE	ALL PREGNANCIES†	PREGNANCIES WITH INFORMATION ON WEIGHT GAIN†	
		MODEL 1	MODEL 2
	odds ratio (95% CI)		
Body-mass index			
≤19.9‡	1.0	1.0	1.0
20.0–24.9	0.7 (0.6–0.8)	0.7 (0.6–0.8)	0.7 (0.6–0.8)
25.0–29.9	0.6 (0.5–0.6)	0.5 (0.4–0.6)	0.6 (0.5–0.7)
≥30.0	0.6 (0.5–0.7)	0.5 (0.4–0.7)	0.5 (0.4–0.6)
Weight gain (kg/wk)			
<0.25			3.0 (2.5–3.5)
0.25–0.34			1.9 (1.6–2.2)
0.35–0.44			1.3 (1.1–1.5)
≥0.45‡			1.0

*Odds ratios have been adjusted for maternal age, parity, education, cigarette smoking, and height and whether the mother was living with the father. CI denotes confidence interval.

†There were a total of 3748 small-for-gestational-age infants born to women with complete data on covariates other than weight gain during pregnancy, of whom 1806 were born to women with available data on weight gain during pregnancy.

‡The women in this category served as the reference group.

TABLE 3. ADJUSTED ODDS RATIOS FOR ADVERSE OUTCOMES ASSOCIATED WITH PREPREGNANCY BODY-MASS INDEX AMONG WOMEN DELIVERING SINGLETON INFANTS IN SWEDEN IN 1992 AND 1993.*

BODY-MASS INDEX	LATE FETAL DEATH (N=418)	EARLY NEONATAL DEATH (N=275)	DELIVERY AT ≤32 WK (N=1322)	DELIVERY AT 33–36 WK (N=6165)
	odds ratio (95% CI)			
≤19.9†	1.0	1.0	1.0	1.0
20.0–24.9	1.3 (0.9–1.8)	1.1 (0.7–1.6)	0.8 (0.7–0.9)	0.8 (0.8–0.9)
25.0–29.9	1.7 (1.1–2.4)	1.1 (0.7–1.7)	0.8 (0.7–1.0)	0.9 (0.8–0.9)
≥30.0	2.7 (1.8–4.1)	1.2 (0.7–2.0)	1.1 (0.8–1.3)	1.0 (0.9–1.1)

*Odds ratios have been adjusted for maternal age, parity, education, cigarette smoking, and height and whether the mother was living with the father. CI denotes confidence interval. For early neonatal death, delivery at ≤32 weeks, and delivery at 33 to 36 weeks, values are based on live births.

†The women in this category served as the reference group.

delivery (at ≤32 weeks) associated with obesity decreased and was no longer significant after this exclusion (data not shown). Excluding women with diabetes did not change these estimates (data not shown).

DISCUSSION

The results of this large, population-based cohort study suggest that the risk of late fetal death consistently increases with prepregnancy body-mass index among nulliparous women, whereas the risk of early neonatal death is almost doubled among nulliparous women with higher body-mass indexes. The pattern of risk among parous women was different; obesity was associated with late fetal death but not with early neonatal death.

Chance is an unlikely explanation for our findings, because of the large sample and the consistency of our results. Besides the adjustment for possible confounding variables, the relatively homogeneous population of women born in Sweden, Denmark, Norway, Finland, or Iceland and the use of standardized records should further minimize the potential for confounding by unmeasured sociodemographic factors or differences in management. Inadequate weight gain has been linked to an increased risk of the delivery of a small-for-gestational-age infant,[6] but its association with other adverse pregnancy outcomes is less certain.[12-16] Weight gain during pregnancy is poorly correlated with prepregnancy body-mass index.[17] In the present study, low weight gain was above all positively associated with the delivery of a small-for-gestational-age infant. Caution is advised in interpreting these results, however, because of the large proportion of women with missing information on weight gain during pregnancy.

Preeclampsia is more common among nulliparous than parous women,[18] and the rates of preeclampsia increase with increasing maternal weight.[19,20] Because preeclampsia may lie on the causal pathway between excessive weight and adverse pregnancy outcomes,[18,21] we did not control for hypertensive diseases in the primary multivariate models. When we excluded nulliparous women with hypertensive diseases, however, the risk of very preterm delivery that was associated with higher body-mass index decreased, whereas the corresponding risk of late fetal death did not change.

The biologic mechanisms underlying the association between increasing prepregnancy body-mass index and a greater risk of late fetal death among nulliparous women remain speculative. Thinner women may have healthier habits or may be more able to perceive a decrease in fetal movements. Maternal overweight and obesity are associated with hyperlipidemia, which reduces prostacyclin secretion and enhances peroxidase production, resulting in vasoconstriction and platelet aggregation.[20] These changes

TABLE 4. ADJUSTED ODDS RATIOS FOR LATE FETAL DEATH AND EARLY NEONATAL DEATH ASSOCIATED WITH PREPREGNANCY BODY-MASS INDEX AMONG NULLIPAROUS AND PAROUS WOMEN DELIVERING SINGLETON INFANTS IN SWEDEN IN 1992 AND 1993.*

BODY-MASS INDEX	LATE FETAL DEATH				EARLY NEONATAL DEATH			
	NULLIPAROUS WOMEN		PAROUS WOMEN		NULLIPAROUS WOMEN		PAROUS WOMEN	
	events/1000	odds ratio (95% CI)	events/1000	odds ratio (95% CI)	events/1000	odds ratio (95% CI)	events/1000	odds ratio (95% CI)
≤19.9†	1.4	1.0	2.6	1.0	1.0	1.0	2.1	1.0
20.0–24.9	2.9	2.2 (1.2–4.1)	2.3	0.9 (0.6–1.3)	1.8	1.9 (0.9–3.8)	1.8	0.8 (0.5–1.2)
25.0–29.9	4.0	3.2 (1.6–6.2)	2.8	1.1 (0.7–1.8)	2.0	1.8 (0.8–4.0)	2.1	0.9 (0.5–1.5)
≥30.0	5.7	4.3 (2.0–9.3)	5.0	2.0 (1.2–3.3)	2.4	2.5 (0.9–6.4)	1.7	0.8 (0.4–1.6)

*The numbers of events were as follows: late fetal death, 173 among nulliparous women and 245 among parous women; early neonatal death, 112 among nulliparous women and 163 among parous women. Odds ratios have been adjusted for maternal age, education, cigarette smoking, and height and whether the mother was living with the father. CI denotes confidence interval. The results of overall tests for interaction between body-mass index and parity with respect to either late fetal or early neonatal death were not significant. For early neonatal death, values are based on live births.

†The women in this category served as the reference group.

TABLE 5. ADJUSTED ODDS RATIOS FOR PRETERM DELIVERY AND DELIVERY OF A SMALL-FOR-GESTATIONAL-AGE INFANT ASSOCIATED WITH PREPREGNANCY BODY-MASS INDEX AMONG NULLIPAROUS AND PAROUS WOMEN DELIVERING LIVE SINGLETON INFANTS IN SWEDEN IN 1992 AND 1993.*

BODY-MASS INDEX	DELIVERY AT ≤32 WK				DELIVERY AT 33–36 WK				DELIVERY OF SMALL-FOR-GESTATIONAL-AGE INFANT			
	NULLIPAROUS WOMEN		PAROUS WOMEN		NULLIPAROUS WOMEN		PAROUS WOMEN		NULLIPAROUS WOMEN		PAROUS WOMEN	
	rate (%)	odds ratio (95% CI)	rate (%)	odds ratio (95% CI)	rate (%)	odds ratio (95% CI)	rate (%)	odds ratio (95% CI)	rate (%)	odds ratio (95% CI)	rate (%)	odds ratio (95% CI)
≤19.9†	1.0	1.0	1.1	1.0	5.3	1.0	4.3	1.0	4.5	1.0	2.7	1.0
20.0–24.9	1.1	1.1 (0.9–1.4)	0.7	0.6 (0.5–0.7)	4.8	0.9 (0.8–1.0)	3.2	0.8 (0.7–0.8)	3.5	0.8 (0.7–0.9)	1.7	0.6 (0.5–0.7)
25.0–29.9	1.3	1.2 (0.9–1.6)	0.7	0.6 (0.5–0.8)	5.4	1.0 (0.9–1.1)	3.4	0.8 (0.7–0.9)	3.2	0.7 (0.6–0.8)	1.5	0.5 (0.4–0.5)
≥30.0	1.7	1.6 (1.1–2.3)	0.9	0.8 (0.6–1.1)	6.2	1.1 (0.9–1.3)	4.2	0.9 (0.8–1.1)	4.2	0.9 (0.7–1.0)	1.4	0.4 (0.3–0.5)

*The numbers of events were as follows: delivery at ≤32 weeks, 675 among nulliparous women and 647 among parous women; delivery at 33 through 36 weeks, 3104 among nulliparous women and 3061 among parous women; delivery of a small-for-gestational-age infant, 2212 among nulliparous women and 1536 among parous women. Odds ratios have been adjusted for maternal age, education, cigarette smoking, and height and whether the mother was living with the father. For preterm delivery, odds ratios are for the comparison with the likelihood of delivery at 37 weeks of gestation or later. CI denotes confidence interval. The results of overall tests for interaction between body-mass index and parity were significant with respect to delivery at ≤32 weeks and delivery of a small-for-gestational-age infant ($P<0.001$ for both) and not significant with respect to delivery at 33 to 36 weeks.

†The women in this category served as the reference group.

may increase the risk of preeclampsia, but they probably occur even in the absence of preeclampsia.

Lean mothers, who are often considered to be underweight, have an elevated risk of delivering small-for-gestational-age infants.[3,8,22] The association between low maternal body-mass index and preterm delivery is less consistent.[12,22,23] In studies in three developed countries, the risks of stillbirth and perinatal or infant death were lowest among infants born to the leanest women,[2,13,24] and the rates of preeclampsia are lowest among lean women.[19] The collective evidence, although limited, is thus compatible with our findings and suggests that pregnancies among lean women should be regarded as characterized by a low rather than a high risk of adverse outcome and that advising lean women to gain weight before becoming pregnant may not be justified.

From the standpoint of primary prevention, adverse pregnancy outcomes related to overweight may, at least theoretically, be preventable. If women with

a body-mass index of 25.0 or more reduced it to 20.0 to 24.9, and thereby reduced their risk of adverse outcomes accordingly, we estimate that the rate of late fetal death would be reduced by 11 percent. If all women with a body-mass index of 20.0 or more reduced it to less than 20.0, the rate of late fetal death would be reduced by 27 percent.

It is important that our results were obtained in a developed country where even lean women are likely to have adequate nutritional stores to meet the basic requirements of pregnancy. These results must not be generalized to developing countries, particularly those in which maternal undernutrition is highly prevalent, nor should they be used to undermine public health efforts to improve prepregnancy and gestational energy intake in areas where the quantity or quality of food is insufficient.

The prevalence of overweight has increased among women in many countries in recent decades.[25-28] In the United States, for example, the prevalence of overweight (body-mass index, ≥27.8) among women 20 to 29 years of age increased from 12.6 percent in 1971 through 1974 to 20.2 percent in 1988 through 1991.[26] In Sweden, the increase of overweight among women has been less prominent, but it is nevertheless indisputable.[27] Although these trends are evident in all demographic subgroups, overweight is more common among less well educated women and, in the United States, among black women.[25-27] Furthermore, the upward trend in the prevalence of overweight is continuing despite its well-publicized adverse effects on health.[29,30] Maternal overweight may be one of the most important preventable risk factors for perinatal mortality and could partly explain the socioeconomic differences in the rates of perinatal mortality in developed countries, especially among nulliparous women. Our findings thus provide further justification for the development of effective strategies to reverse the trends toward increasing body weight and a higher prevalence of overweight.

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