Sociocultural and behavioral influences on weight gain during pregnancy[1–4]

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ABSTRACT Studies have consistently identified a positive association between prenatal weight gain and birth weight. Much less, however, is known about factors that may influence women to gain weight within currently recommended ranges. The importance of this issue is suggested by recent reports indicating that only 30–40% of women actually gain weight within these ranges. This paper examines demographic, sociocultural, and behavioral factors that are associated with, and may influence risk of, low prenatal weight gain among adult women with low and normal body mass indexes. Available data suggest that these factors include ethnicity, socioeconomic status, age, education, pregnancy intendedness or wantedness, prenatal advice, and psychosocial characteristics such as attitude toward weight gain, social support, depression, stress, anxiety, and self-efficacy. Potential theoretical models for these associations include biological, behavioral, and mixed pathways. The design of targeted intervention studies will depend on further identification and characterization of sociocultural and behavioral risk factors that, along with reproductive and nutritional characteristics, may predict which women are most likely to have inadequate prenatal weight gain. *Am J Clin Nutr* 2000;71(suppl):1364S–70S.

KEY WORDS Prenatal weight gain, demographics, socioeconomics, culture, psychosocial risk factors, behavioral risk factors, pregnancy weight gain, birth weight

INTRODUCTION

Studies have consistently identified a positive association between prenatal weight gain and birth weight (1). Studies published in the past 10 y (2–9) have validated the 1990 Institute of Medicine (IOM) guidelines for weight gain during pregnancy (1), which are based on pregravid body mass index (BMI; in kg/m^2). Prenatal weight gain within the suggested range for each pregravid BMI category is associated with more favorable outcomes than is weight gain above or below the suggested range. These outcomes include a reduction in the prevalence of low-birth-weight infants (<2500 g) (6), small-for-gestational age infants (2, 3), large-for-gestational age infants (2), high-birth-weight infants (>4500 g) (6), cesarean deliveries (2), and preterm deliveries (4, 5), as well as an increase in mean birth weight (3, 7).

Much less, however, is known about factors that may influence women to gain or not gain weight within the recommended ranges. The importance of this issue is suggested by reports (8–14) indicating that only 30–40% of women actually gain weight within these ranges during their pregnancies. This paper examines recent reports of demographic, sociocultural, and behavioral factors that are associated with, and may influence the risk of, low prenatal weight gain among adult women of low and normal BMI who deliver at term. Low weight gain is defined by using the lower limit of the IOM range when possible (<11.5 kg for BMIs <19.8 and <12.5 kg for BMIs from 19.8 to 26) or the cutoff point specified in the study being reviewed.

DEMOGRAPHIC CHARACTERISTICS OF WOMEN WITH LOW PRENATAL WEIGHT GAIN

The 1989 revision of the US Standard Certificate of Live Birth included prenatal weight gain for the first time (15). In 1995, the District of Columbia and all states except California included this item on their birth certificates, representing 86% of all births in the United States (16). Unfortunately, this weight gain information is based on the answer to a single question about the amount of "weight gained during pregnancy" in pounds; pregravid weight and height data are not collected. These data, as published, can only be examined in terms of the incidence of prenatal weight gain <16 lb (<7.3 kg), an amount that would be considered inadequate regardless of pregravid BMI. Other national sources of information on prenatal weight gain include the 1988 National Maternal and Infant Health Survey (NMIHS; 10, 17), the Centers for Disease Control and Prevention (CDC) Pregnancy Nutrition Surveillance System (PNSS; 18, 19), and the Pregnancy Risk Assessment Monitoring System (20). These data sets do include pregravid weight and height.

Ethnic origin

US birth certificate data for 1995 indicate that 10.4% and 9.3%, respectively, of women completing 37–39 wk and ≥40 wk

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of gestation gained <7.3 kg (16). The incidence of prenatal weight gain <7.3 kg for these gestational lengths was highest among non-Hispanic black women (15.5% and 14.0%, respectively), followed by Hispanic women (12.4% and 11.2%, respectively) and non-Hispanic white women (8.8% and 8.0%, respectively). Among Hispanic women delivering at ≥40 wk gestation, the incidence of prenatal weight gain <7.3 kg was highest for women of Mexican origin (13.6%), followed by women of Puerto Rican (12.5%), Central and South American (10.6%), and Cuban (6.9%) origin. Substantial differences in the incidence of low weight gain have also been reported for women in other ethnic groups. Disregarding gestational length, 14.8% of American Indian, 11.2% of other Asian or Pacific Islander, 9.9% of Japanese, 8.2% of Hawaiian, 7.4% of Filipino, and 6.3% of Chinese women gained <7.3 kg prenatally in 1995 (16).

The 1988 NMIHS was a systematic sample (by race, age, marital status, and birth weight strata) of women who had live births in the United States in 1988 (10). Women were interviewed between 10 and 18 mo after delivery; information was obtained on pregravid weight, height, and weight gain during pregnancy. The NMIHS estimates are representative of 1 322 820 white and 205 507 black women aged ≥15 y with BMIs ≤29 who delivered singleton, term infants (≥37 wk gestation). Half (50.0%) of underweight black women (BMI < 19.8) and more than one-third (35.7%) of underweight white women reported prenatal weight gain that would be considered low (<12.5 kg) according to IOM guidelines. Similarly, 36.1% of black women and 24.7% of white women with average BMIs reported low weight gain (<11.5 kg). These differences in the incidence of low weight gain among black and white women have been confirmed by ≥3 other studies (3, 11, 21) as well as by 1993 CDC PNSS data (18, 19).

Siega-Riz and Hobel (14) reported that 26.9% of 4791 nonobese (BMI < 26.0) Hispanic women had poor prenatal weight gain (<9.5 kg). These women were predominantly low-income, recent Mexican immigrants attending public health clinics in West Los Angeles. The CDC (12) used data from the PNSS to examine prenatal weight gain in 4840 migrant farm workers in 4 eastern states during 1989–1993. Most of the farm workers (58.4%) were Hispanic; 28.7% were white, non-Hispanic; and 11.1% were black, non-Hispanic (1.8% were other). More than half (52%) gained less than the IOM guidelines for their BMI, compared with 31.6% of 610 728 nonmigrant women. All were enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). The US work force includes an estimated 3–5 million migrant and seasonal farm workers and ≈16% of these are women (12). Although these data may not represent the total pregnant migrant worker population because data were not available from western states or from women not enrolled in the WIC program, they suggest that migrant workers may also be a group at high risk for low prenatal weight gain.

Socioeconomic status

Data from the 1980 National Natality Survey (21) indicated that the risk of low weight gain (<7.3 kg) increased nearly 2-fold as annual household income fell from ≥$30 000 (9.0% low weight gain) to <$9000 (15.9% low weight gain). More recent nationally representative data by income category are not available. However, the CDC PNSS provides data for low-income women who participate in publicly funded health, nutrition, and food assistance programs in 22 states, the District of Columbia, the Navajo Nations, Puerto Rico, and American Samoa (18, 19). The system is limited by variation in data quality and completeness, as well as by the fact that it is a convenience rather than a random sample of low-income women (18, 19). However, in 1993, one-third (33%) of the women included in the PNSS experienced low weight gain, as defined by the lower limit of the IOM guidelines.

Maternal age and parity

Prenatal weight gain has also been linked to maternal age and parity. Primiparas have been reported to be less likely to have low weight gain (<6.8 kg) than multiparas, but little difference has been observed by age or parity among multiparas (17). Analyses of 1994 data from the CDC PNSS used the 1990 IOM guidelines to evaluate pregnancy weight gain by pregravid BMI categories (19). Women aged ≥30 y were the most likely to gain less than the IOM guidelines and the least likely to gain more.

Maternal education and marital status

US national data for 1992 indicate that weight gain increases with educational attainment; gains of <7.3 kg are nearly 3 times as common (14%) for women with less than an elementary school education as for women with ≥16 y of schooling (5%) (22). Unmarried mothers are more likely than married mothers to gain <7.3 kg (13% compared with 8%).

Multivariate analyses of demographic characteristics

Kleinman (17) used 1980 National Natality Survey data on maternal ethnicity, age, parity, and education for married mothers with live singleton births in a logistic regression model with low weight gain (<6.8 kg) as the dependent variable. (The model also included smoking, alcohol consumption, height, and pregravid BMI.) Black women had a 71% greater risk and Hispanic women a 100% greater risk of low weight gain than white women. Mothers with <12 y of education had a 63% greater risk and mothers with 12 y of education had a 26% greater risk of low weight gain than mothers with >12 y of education. Primiparas were less likely to have low weight gain than multiparas but there was little difference by age or parity among multiparas. Overall, however, the variables in this analysis accounted for <5% of the variance in maternal weight gain.

Caulfield et al (11) reported that only 28.2% of 2617 black and 32.5% of 1253 white women with singleton pregnancies of ≥28-wk duration experienced prenatal weight gain within the ranges suggested by the IOM guidelines. Black women were 1.51 (95% CI: 1.23, 1.85) times more likely to undergain and 0.89 (95% CI: 0.74, 1.08) times less likely to overgain than white women (adjusted odds ratios). Multinomial regression analysis identified maternal pregravid BMI, height, parity, education, smoking, blood pressure, race, length of pregnancy, and sex of the fetus as risk factors for under- or overgain in this population. Maternal age, diabetes status, and provider type (managed care, hospital obstetrical department, or private practice) were not statistically significant and were dropped from the final model. No interactions were found between any factor examined and BMI or race.

Siega-Riz and Hobel (14), in a study of 2988 underweight and normal-weight (BMI <26) Hispanic women, found that only short stature (<157 cm) was associated with an increased adjusted odds ratio (AOR: 1.5; 95% CI: 1.24, 1.84) for low weight gain (<9.5 kg). Factors associated with a decreased risk of low weight gain included being US born, being primiparous and <29 y of age, planning the pregnancy, and having a close relative die during the pregnancy.

Finally, note that a study by Abrams et al (23) suggested that when rates or patterns of maternal gain (rather than total gain) are considered, the effect of individual sociodemographic factors (ie, race or ethnicity, age, and parity) may vary by trimester. The most important maternal predictors of first trimester weight gain were age (negative association) and Asian race or ethnicity (negative association). During the second trimester, pregravid body mass was most predictive (negative association), followed by parity (negative association) and black race or ethnicity (negative association). In the third trimester, maternal hypertension (positive association), age (negative association), and parity (negative association) were the most important predictors.

BEHAVIORAL CHARACTERISTICS OF WOMEN WITH LOW WEIGHT GAIN

Smoking and alcohol use

Kleinman (17) used a logistic regression model to analyze 1980 National Natality Survey data on smoking and alcohol consumption for married mothers with live singleton births with low weight gain (<6.8 kg) as the dependent variable. As noted above, the model also included ethnicity, age, parity, education, height, and pregravid BMI. Smokers had a 46% greater risk of low weight gain than did nonsmokers. Mothers reporting light alcohol consumption (≤2 drinks less than once a month) had a 24% smaller risk for low weight gain and mothers reporting moderate alcohol consumption (those who drank more than once a month or >2 drinks when they drank) had a 47% smaller risk of low weight gain relative to nondrinkers. A more recent study did not find differences in prenatal weight gain among mothers consuming different amounts of alcohol compared with nondrinkers (24). Data from the 1995 Behavioral Risk Factor Surveillance System indicated that 16.3% of pregnant women surveyed reported consuming at least one drink during the previous month (25). Approximately 3.5% reported frequent drinking (consumption of an average of ≥7 drinks/wk or ≥5 drinks on at least one occasion), which placed their infants at risk for adverse effects, including fetal alcohol syndrome, regardless of prenatal weight gain (25).

An estimated 26% of US women of reproductive age (18–44 y) smoked in 1993, and ≈19–27% of women smoked during pregnancy (26). Maternal smoking appears to cause fetal growth restriction through both nonnutritional and nutritional routes, and the results of numerous studies suggest that smoking and maternal weight gain during pregnancy are independent, additive predictors of birth weight (1, 27). Muscati et al (28) estimated that the etiologic fraction of fetal growth restriction attributable to smoking is 30.8%, whereas 16.7% is attributable to low pregravid weight of the mother, and 15.3% is attributable to low prenatal weight gain. In another study of smoking and weight change during pregnancy, 36.4% of normal-weight women (BMI: 19.8–26) and 41.7% of obese women (BMI >29) who smoked were observed to have prenatal weight gain below the IOM guidelines, compared with 23.2% and 36.0%, respectively, of normal-weight and obese nonsmokers (29). Mongoven et al (30) reported that white, non-Hispanic pregnant smokers (≥5 cigarettes/wk) who quit smoking before 28 wk gestation were half as likely to have total weight gains below the IOM guidelines [relative risk (RR): 0.47; 95% CI: 0.27, 0.81] as women who continued to smoke. They were also 1.74 times more likely to have weight gains above the IOM recommendations (95% CI: 1.21, 2.51).

Pregnancy intendedness and wantedness

Reports on the association of pregnancy intendedness or wantedness with subsequent maternal weight gain are few and mixed. Among 536 nonobese (BMI ≤ 26.0) low-income black women, having a mistimed but wanted or having an unwanted pregnancy was associated with a doubling of the AOR (2.0; 95% CI: 1.2, 3.2) for low weight gain (≤10 kg) compared with wanted pregnancies (31). A similar association was not observed among 270 white women (AOR: 1.0; 95% CI: 0.6, 1.9) in the same study. Among 4245 Hispanic women (BMI < 26), having a planned compared with an unplanned pregnancy was associated with a decreased AOR (0.82; 95% CI: 0.67, 1.00) for low weight gain (<9.5 kg), although the 95% CI included 1.0 (14). Conversely, in a multivariate examination of first pregnancies in 6015 relatively young (aged 19–27 y) black, Hispanic, and white primiparous women included in the National Longitudinal Survey of Labor Market Experiences of Youth (32), pregnancy wantedness was not a significant predictor of very low prenatal weight gain (defined as ≤6.8 kg regardless of BMI).

More recently, Kost et al (33) completed multivariate analyses of data from the 1988 NMIHS and the 1988 National Survey of Family Growth to determine whether women with unplanned births differed from other women in their pregnancy behaviors, independent of their social and demographic characteristics. Women with intended conceptions were more likely than similar women with unintended pregnancies to recognize early signs of pregnancy and to seek out early prenatal care and were somewhat more likely to quit smoking. However, they were not more likely than women with comparable social and demographic characteristics to adhere to a recommended schedule of prenatal visits once they began care, to reduce alcohol intake, or to follow their clinician's advice about taking vitamins and gaining weight.

Response to weight gain advice

The US Public Health Service Expert Panel on the Content of Prenatal Care issued a report in 1989 that made specific recommendations regarding the procedures and advice to be included within the context of prenatal care (34). The Expert Panel recommended that pregnant women receive advice in 7 areas: *1*) breastfeeding; *2*) reducing or eliminating alcohol use; *3*) reducing or eliminating smoking; *4*) not using illegal drugs such as marijuana, cocaine, or crack; *5*) eating the proper foods during pregnancy; *6*) taking vitamin or mineral supplements; and *7*) gaining an appropriate amount of weight during pregnancy. Subsequent studies examined the influence of the Expert Panel's recommendations on birth outcomes (35–37). However, the influence of specific and documented weight gain advice on observed prenatal weight gain in US women of known pregravid BMI categories has not been examined in prospective randomized, controlled intervention trials.

Differences in weight gain have been reported for the intervention and control groups in several US and Canadian studies of women with unspecified pregravid BMI in which pregnancy outcome, rather than maternal weight gain, was the primary outcome variable (38–42). The interventions in these studies included nutrition advice alone (39) or such advice linked with other interventions, including home visits by nutritionists (38), supplemental food (38, 41), a nurse home visitation program (40), and the provision of prenatal care through multidisciplinary rather than traditional clinics (42). Although the positive direction of the difference reported for mean weight gain in each of the studies favored the intervention group, in 3 of the

5 studies these differences were not statistically significant (38, 40, 42). In the other 2 studies (39, 41), differences between the control and intervention groups in the time periods (gestational weeks) between baseline and final weight observations could have accounted for a considerable proportion of the increased weight gain reported for the intervention groups. Additionally, because these studies were completed before release of the IOM guidelines (1), only mean weight gain was reported; no attempts were made to assess weight gain by using a range or cutoff point based on pregravid BMI.

Brown et al (43) developed a prenatal weight gain intervention program based on social marketing methods, which included focus groups among prenatal clinic patients before the design of the intervention. The program was implemented in 2 public health clinics and a third clinic served as a control site (44). Unfortunately, several unexpected circumstances arose during the study (44) that hampered an evaluation of the intervention; these included a decline in clinic enrollment and changes in the control clinic protocol to emphasize greater weight gain. However, preliminary evidence indicated that prenatal weight gain and birth weights of African Americans in the intervention group did not differ significantly from those of whites, whereas both weight gain and birth weight were significantly lower in African Americans than in whites in the control group (44).

A report by Taffel et al (45), based on analysis of data from the 1988 NMIHS, indicated that only 12% of white mothers reported receiving advice regarding prenatal weight gain that did not meet the minimum standard in effect in 1988 (10 kg), and only 19% reported receiving advice that did not meet the minimum IOM recommendation (1) for their pregravid BMI. In contrast, a significantly higher proportion of black mothers reported receiving advice to gain <10 kg (33%) or less than the lower limit of the IOM guidelines (34%). The higher frequency of inappropriate advice reported by black mothers could not be explained by differences in pregravid BMI, age, education, parity, marital status, or site of care. Nevertheless, because apparent compliance with the perceived advice was almost the same for black and white mothers (>70% gained ≥10 kg when this was the reported weight-gain advice), Taffel et al suggested that it is entirely feasible that more appropriate weight-gain advice for black women would result in more appropriate weight gain.

Although the combined evidence from the above studies suggests a potential relation between prenatal nutrition advice and prenatal weight gain, the many threats to the validity of inference in these, as well as other studies of the specific components of prenatal care, need appraisal (46). These include, in addition to differences in pregravid nutritional status and BMI, issues such as self-selection bias, recall bias, differences in time during gestation when nutrition advice was given, variation in content and frequency of advice, the pairing of advice with other food or nonfood interventions, individual and social characteristics of the provider as contrasted with those of the pregnant woman, and disparities in weight gain advice given to women from different ethnic (45) and socioeconomic (47) groups.

BELIEFS, ATTITUDES, AND KNOWLEDGE OF WOMEN WITH LOW PRENATAL WEIGHT GAIN

There have been many studies of dietary intake during pregnancy; some of them have examined the influence of beliefs, attitudes, and knowledge on eating behavior and dietary intake. These studies will not be reviewed because they do not provide information on prenatal weight gain. Several studies have examined beliefs, attitudes, and knowledge related to body weight or weight gain in pregnancy (48–53). Three (51–53) of the latter have examined the association between attitude toward gain and actual weight gain during pregnancy. Only one study (53) tested the association between attitude toward gain and low prenatal weight gain in women with documented pregravid BMI or weight-for-height categories. None have presented analyses by ethnic group.

Palmer et al (51) developed a Likert-format questionnaire with 18 statements expressing attitudes of pregnant women toward their own prenatal weight gain. Positive attitude scores among 29 white, mainly middle-class women with at least a high-school education were reported to be significantly associated with higher actual weight gain ($P < 0.025$). Stevens-Simon et al (52) used the same Palmer scale (51) in a study of 99 ethnically diverse, pregnant 13–18-y-olds and reported that weight gain was significantly related to 4 of the 18 scale items but not to the total attitude scale score. Copper et al (53) administered the Palmer scale (51) to 1000 black (69%) and white (31%) adult, low-income pregnant women and reported that the attitude score was not significantly related to prenatal weight gain ($r = -0.05$, $P = 0.08$). Maternal attitude toward weight gain was found to be influenced by pregravid body size; thin women tended to have positive attitudes and obese women tended to have negative attitudes about weight gain [as was the case with adolescents in the study of Stevens-Simon et al (52)]. However, within BMI groups, a positive attitude did not predict appropriate weight gain (defined ≥10 kg). No significant differences in attitude scores were reported between black and white women in any pregravid BMI category; data for the association between attitude score and weight gain were not reported separately by ethnic group.

The mixed and conflicting results from studies using the Palmer scale (51) to examine attitudes toward prenatal weight gain are not unexpected, given that the scale was originally developed to examine attitudes among women with entirely different sociodemographic and cultural characteristics, ie, a small group of middle class white women. McLean et al (54) observed that successful tests of etiologic hypotheses and the development of targeted interventions to address the excess rates of adverse pregnancy outcomes among black women depend critically on valid, reliable measures that are specific to black women. This generalization would seem to hold true for low weight gain and for women in other sociodemographic categories as well and serves to underscore the need for community-based ethnographic examinations of low prenatal weight gain that are specific to the defined target population. A careful reading of the studies cited in this paper shows that, with the exception of the study by Brown et al (43, 44), all either took place in research clinic settings removed from the community or were based solely on the analysis of existing data sets. Rarely have women with low prenatal weight gain or the community-based health care providers with whom they interact been actively involved as collaborators or as co-investigators. In general, hypotheses have been imposed from the literature rather than being generated through community-based observations or by the community members themselves. Rarely, if ever, have the data gathered, the observations made, and the hypotheses generated or tested been made available for comment or validation by the women involved as a part of the research process.

CULTURAL INFLUENCES ON PRENATAL WEIGHT GAIN

More than 10 y ago, Pelto (55) completed an assessment of available studies targeting cultural issues in maternal and child health and nutrition. Her challenge for social scientists remains true today, ie, we have yet to thoroughly and empirically examine cultural and behavioral adaptations to the changed energy and nutrient requirements of pregnancy. Although the literature in anthropology and sociology contains numerous examples of the dietary cravings and food proscriptions attributed to pregnant women, these have almost always been discussed from a symbolic, psychological, or ethnoscientific perspective, rather than in a manner that would allow an assessment of their nutritional consequences (56).

Sociocultural dimensions that may provide a framework for examining cultural issues related to prenatal weight gain include gathering information on ideologic (belief) structures related to appropriate food intake, food proscriptions, activity patterns, weight gain, and body image during pregnancy, as well as the relation of these to household and community characteristics. Concomitantly, this information must be paired with data on observed patterns of behavioral adjustment, energy expenditure, and weight gain. Finally, both types of data may need to be stratified at the subcultural level, even within what at first appear to be fairly homogeneous ethnic and socioeconomic groups.

PSYCHOSOCIAL CHARACTERISTICS OF WOMEN WITH LOW PRENATAL WEIGHT GAIN

A separate but related area of inquiry has suggested that maternal psychosocial characteristics may influence prenatal weight gain. During the past 15 y, studies have explored the associations of social support (14, 57–59), depression (14, 58, 60, 61), stress (14, 58, 61, 62, 63), trait anxiety (58), mastery (58), and self-esteem (58) with prenatal weight gain. In each case, the results of these preliminary studies were mixed, depending on the assessment instrument used, the population studied, and the type of statistical analysis used (bivariate or multivariate). Additionally, this area of research is complicated by cross-cultural and subcultural differences in the perception and meaning of individual psychosocial characteristics or states, and thus by the related issue of culturally appropriate assessment measures (64, 65) that are suitable for use in the clinical setting (66, 67). For example, likely explanations for the lack of association between maternal psychosocial status and low prenatal weight gain among black compared with white women (58) may involve the following: *1*) different perceptions of what constitutes psychosocial stress (65), ie, perceptions not tapped by the scales used in the study; *2*) variation in biological and behavioral responses to specific stressors (65); *3*) variation in the availability of stress mediators (65, 68); or *4*) the existence of entirely separate mechanisms for low prenatal weight gain among black women. Examples of the latter would include differences in the nutrition-related content of prenatal care provided to black women (35, 45).

If these preliminary studies of psychosocial status and prenatal weight gain are confirmed, an examination of the overall literature related to psychosocial determinants of pregnancy outcome suggests ≥2 theoretical pathways for the observed association with weight gain. Maternal psychosocial stress may function to affect pregnancy outcome through neuroendocrine-mediated alterations in the complex physiologic responses to pregnancy (69, 70). These alterations could also affect pregnancy-related adjustments in basal and resting metabolism and the efficiency with which energy is used to synthesize new tissue, making it more difficult for women to achieve the positive energy balance necessary for gain in maternal and fetal tissue. Alternatively, and perhaps concurrently with possible neuroendocrine-mediated alterations in prenatal energy metabolism, poor psychosocial status may interfere with the achievement of a positive energy balance through stress-related changes in sleep patterns, physical activity, appetite, food intake, tobacco use, or other behaviors. These potential associations have not been examined in studies reported to date.

The study by Picone et al (62, 71) provides support for a hypothesized catecholamine-mediated effect of stress on prenatal energy metabolism. In that study, psychosocial stress (assessed by using an abbreviated Holmes-Rahe life events questionnaire; 72) was correlated negatively with prenatal weight gain ($r = -0.35$, $P < 0.01$) but not with energy intake, suggesting that the utilization of dietary energy was less efficient in women experiencing stress. Caan and Petitti (73), in a comment on the Picone study, calculated that "nonsmokers in the low weight gain group consumed a mean of 1617 cal/day to gain a mean of 5.4 lb in their pregnancy (299 cal/day/lb), whereas nonsmokers in the average weight gain group consumed a mean of 1905 cal/day to gain a mean of 32.7 lb (58 cal/day/lb)." This suggested that differences in both energy intake and energy utilization were associated with variations in psychosocial stress.

CONCLUSION

The studies cited above, when considered as a group, suggest the following: *1*) Low prenatal weight gain, despite its documented association with poor pregnancy outcomes, continues to be a problem for a significant proportion of under- and average-weight women enrolled in a variety of health, nutrition education, and food assistance programs. *2*) In the United States, the incidence of low weight gain varies considerably by ethnic group, education, marital status, age, parity, smoking status, and pregnancy planning status. *3*) Certain psychosocial characteristics (depression, trait anxiety, and low levels of mastery and self-esteem) may be associated with ethnic group–specific increases in the incidence of low weight gain. *4*) There are no published prospective, randomized controlled trials of nutritional or other interventions targeting low prenatal weight gain per se (rather than pregnancy outcome) among US women with low and average pregravid BMIs. *5*) The design of such intervention trials would be enhanced if informed by the community-based identification and characterization of risk factors specific to the intended target groups (ie, by community-based hypothesis generation and refinement). *6*) Low prenatal weight gain may be more amenable to analysis and to intervention if it is conceptualized in terms of a biopsychosocial model (74) that explicitly recognizes the individual and interacting influences of biomedical, psychosocial, and lifestyle factors.

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