Research Roundtable Summary

12

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Research Projects

Body Composition in Pregnant Women

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Reaction

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About This Series

The Research Roundtable Series, sponsored by the Maternal and Child Health Bureau (MCHB), disseminates the results of MCHB-funded research to policymakers, researchers, and practitioners in the public and private sectors. The results of these projects influence future service, research, and policy development. The Research Roundtable sessions provide an opportunity for researchers to discuss their findings with policymakers, MCH program directors, service providers, and other health professionals.

The Maternal and Child Health Research Program is directed by Dr. Gontran Lamberty and administered through the Division of Systems, Education and Analysis, Maternal and Child Health Bureau, Health Resources and Services Administration (HRSA). HRSA is a component of the Public Health Service (PHS), part of the U.S. Department of Health and Human Services (DHHS). The purpose of the research program is to support applied research relating to maternal and child health services that shows promise of making a substantial contribution to the advancement of those services.

Introduction

Dr. Gontran Lamberty introduced the speaker, Sally A. Lederman, Ph.D., a professor of Human Nutrition at Teacher's College, Columbia University. Dr. Lederman is known for her research on body composition and pregnancy weight gain. She has published extensively in medical and nutritional journals. Reaction was provided by Kathleen Rasmussen, Sc.D., a professor in the Division of Nutritional Sciences at Cornell University. She has published extensively in medical and nutritional journals and was a past member of the MCHB Research Grants Review Committee.

Presentation

Statement of the Problem

Weight gain during pregnancy has repeatedly been associated with infant birthweight. Birthweight, in turn, is highly associated with perinatal mortality, even in infants delivered at term. Why birthweight and maternal weight gain are associated is not known. Despite the lack of a detailed mechanism demonstrating a causal relationship, it is common practice to encourage maternal weight gain in the expectation that appropriate weight gain will optimize fetal development.

In 1990 the Institute of Medicine (IOM) issued new weight gain guidelines for pregnancy, recommending that underweight women gain 28–40 pounds (12.5–18 kg); normal weight women

should gain 25–35 pounds (11.5–16 kgs); overweight women should gain 15–25 pounds (7–11.5 kgs); and obese women should gain at least 15 pounds (6 kgs). The recommendations were determined after a review of the literature that associated weight gain with pregnancy outcomes. There were no studies addressing the issue of how maternal weight gain and body composition changes, particularly fat gain, were related. In addition, little information was available relating maternal fat or other body component changes to birthweight. What information had been reported was generally based on simple and imprecise estimates of body composition. Yet there is much interest in studying fat gain during pregnancy, since the conventional wisdom has been that pregnancy weight gain and fat gain contribute to obesity among women in the United States.

To understand the relationship between maternal weight gain and fat gain, it was necessary to study weight gain and body composition changes in a sufficiently large sample so that different body mass index (BMI) subgroups could be examined separately. Because there is persisting concern about differential birth outcomes in African-American, white, and Hispanic women, the study included women from these groups.

Research Objectives

The main purpose of this research was to test the following hypotheses:

1. There is a positive correlation between gestational weight gain and body fat gain in pregnant African-American and white adult women;
2. White women store more fat than African Americans during pregnancy, after adjusting for gestation duration, initial body fat, height, parity, and age; and
3. Fetal growth is greater in whites than in African Americans after adjustment for initial body fat, height, parity, age, gestation duration, and baby's sex.

A positive correlation between fetal growth and gestational fat mass increase in both ethnic groups was postulated. Therefore, fat mass increase will be a significant covariate of fetal growth.

Study Design and Methods

Two-hundred nonsmoking, healthy, African-American, white, and Hispanic women, ages 18–36, were recruited from prenatal care clinics located at Harlem Hospital Center, Presbyterian Hospital, St. Luke's Roosevelt Hospital, and the Maternity Center, all in New York City. Body composition was measured twice during pregnancy, at weeks 14 and 37 on average. Many different body composition measures were used, so that in addition to the researchers' determination of body fat using the most advanced body composition models, a variety of approaches to body composition assessment could be evaluated. Selected measurements obtained were combined with bone mineral mass measurements determined at 3 weeks postpartum and used in a multicompartment model to estimate changes in fat and lean tissue during the measurement period. The fat estimate obtained in this way for each woman was used to evaluate historical approaches to body composition assessment, including estimates based on anthropometry, total body water, body density, and total body potassium.

Findings

The study showed that as weight gain increased during pregnancy, fat gain increased in all BMI categories. Underweight women, who had the highest recommended weight gain, gained the most fat between weeks 14 and 37 when gaining as recommended. Obese women who gained the recommended weight did not gain body fat during the measurement period. Weight gain, fat gain, and birthweight did not differ among the African-American and white women.

An array of biological and demographic variables were examined for a relationship to birthweight, by means of backward elimination regression analyses. The key findings of these analyses were that higher weight gain was associated with increased birthweight, but higher fat gain was associated with lower birthweight. Second, when total body water was studied in place of fat gain, higher body water was associated with increased birthweight and weight gain was no longer an independent predictor of birthweight.

Study of predictor anthropometric equations for the prediction of body fat demonstrated that these equations, which were developed on nonpregnant women, significantly mis-estimated body fat, particularly at the second measurement (at or after 37 weeks' gestation). New equations were developed using a random half of the study population. In an internal validation study, these equations predicted fat at weeks 14 and 37 and fat change from week 14 to 37 in the remaining sample of women.

The methodological studies of the standard methods used traditionally to estimate body composition (underwater weighing, total body water, and total body potassium) indicate that they can give significantly different estimates of body fat when each measure is used separately. Preliminary data have been reported that compare these methods and allow fuller interpretation of differences in fat changes reported in studies using the different methods.

The anthropometric equations developed in this study should be tested for use in the clinical setting so that women whose fat gain near term has been high can be identified and counseled before delivery about postpartum weight control measures that might be advisable. Further study of the factors that interfere with loss of gestational fat gain is also needed.

Studies should be directed at determining whether specific dietary patterns can influence the partitioning of nutrients between the mother and the infant, so that birthweight can be optimized while maternal fat gains are limited. Finally, efforts are needed to assist breastfeeding women during the early weeks of lactation, especially given the recent shortening of postpartum hospital stays.

Reaction

At the time this research was funded (1990), an expert committee at IOM was issuing the first new recommendations in two decades on weight gain during pregnancy. These recommendations were for different gains depending on the mother's prepregnant BMI value, and, for some groups of women, the recommended gains were substantially higher than the previous recommendations of 12.5 kg for all women, regardless of their prepregnant size. This was not true for overweight/obese women. The recommended gains were, in general, still lower than actual gains by American women. These recommendations were made with the health of the developing fetus in mind. This opens these recommendations to the criticism that they may be too high for optimal maternal health.

On a population basis, it is possible to separate the effects of childbearing from those of getting older; as women age, their bodies gain about 0.25–0.3 kg/year; from ages 20 to 45, this amounts to 6.5–7.5 kg. As women bear children, many experience gains of about 1 kg/child; American women have about two children each, for a gain attributable to childbearing of only 2 kg, about a third of the gain attributable to aging. Research has shown that the more a woman gains, the more weight she is likely to retain. In one study it was estimated that a woman might retain half of what she gained that was above the recommended gain. These calculations tell nothing about the composition of the gain women experience during this period of their lives.

Several groups of researchers had previously studied fat gain during pregnancy among relatively small groups of women. For example, Elisabet Forsum in Sweden recruited 22 Caucasian women before they became pregnant and studied them prospectively until 6 months after delivery. She identified which fat deposits increased the most during pregnancy. The study also provided

estimates of total fat gain as well as the pattern of this fat gain during pregnancy. The greatest rate of gain occurs during the first trimester, the gain slows in the second trimester, and women may lose fat during the third trimester. These results were based on measurements of various skinfold thicknesses and deuterium dilution that used a traditional model and the best equations available at the time. How then does Dr. Lederman's study add to the body of knowledge about this subject?

First, Dr. Lederman studied a sufficient number of African-American and Hispanic women. Thus, it is possible to examine their results separately from those of white women. Previously, data for these subgroups had been conspicuously unavailable.

Second, in contrast to others who have studied changes in body composition prospectively during pregnancy, Dr. Lederman included enough subjects so as to be able to relate weight gain and fat gain to the outcome of pregnancy as reflected in birthweight. Both birthweight and weight gain are highly variable, so this requires a much larger sample of women than has previously been studied in this much detail.

Third, Dr. Lederman used a more sophisticated and appropriate model of body composition during pregnancy. Thus, her results should be more accurate.

Fourth, by characterizing her women by whether their weight gain was more or less than that recommended, Dr. Lederman was able to show that the recommended amounts were not disadvantageous to her subjects. This provides strong support for the current recommendations: Women need not fear excessive gains of fat if they gain weight according to the recommendations. Dr. Lederman confirmed that excessive gains of weight do result in excessive gains of fat and thus are to be avoided.

The most interesting finding pertains to the analysis outside of her original plan and has produced fascinating results. It is well known that every extra kg of weight gain results in a relatively small increment in birthweight. Dr. Lederman replicated this result to week 37. She was able to show that every extra kg of maternal fat gain resulted in a lower birthweight (here -27 g birthweight/kg fat gain). This seems counterintuitive because fat gain is a part of weight gain and if weight gain is positively associated with birthweight, one might expect that fat gain would be also. However, one can make another argument that is equally plausible: During pregnancy, fat is first gained by the mother early in pregnancy; later in pregnancy, maternal stores are depleted somewhat to support the high rates of fetal growth. Thus, if the mother doesn't release this fat or continues to gain herself at a high rate, she'll stay fat and the baby will weigh less than expected.

Several decades ago, researches called the fetus a “perfect parasite” and spoke of competition between mother and fetus for available nutrients. These are probably not the ideal terms to use to discuss the way available nutrient stores and dietary intake are divided between mother and fetus; it is probably more appropriate to borrow a term from the study of lactation, “nutrient partitioning.” Our experiments in undernourished rats also show that maternal nutritional status influences nutrient partitioning between the rat dam and her litter. As malnutrition becomes more severe, the total amount of weight gained is reduced, but the proportion that is devoted to the fetuses and their support increases at the expense of the mother's gain. We investigated this phenomenon in undernourished women, using data from a supplementation trial in Guatemala that was carried out in the 1970s. These data show that among women with the lowest body fat values, supplementation produces a large gain in birthweight and no change in maternal weight. In contrast, among women with the highest body fat values in this sample, supplementation produced a much lower improvement in birthweight and a substantial gain in maternal weight.

Conclusion

Discussion questions addressed what advice primary care providers should give to women about weight gain during pregnancy. Also discussed were the comparisons and limitations that can be stated from this research for other ethnic groups, such as Asian Americans.

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