Original Study

Preconception Nutrition, Physical Activity, and Birth Outcomes in Adolescent Girls

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A B S T R A C T

Study Objective: Recommendations for preconception care usually include optimal nutrition and physical activity, but these have not been tested extensively for their relationship with birth outcomes such as low birth weight and preterm birth.
Design: Data from Waves I, II, and IV of the National Longitudinal Study of Adolescent Health (Add Health) contractual dataset were used.
Methods: In Wave I in-home interview, participants were asked to recall their frequency of having 5 types of food on the previous day, including milk, fruit, vegetables, grains, and sweets. At Wave II, participants reported the previous day's intake of 55 items, and results were categorized into high-calorie sweet, high-calorie nonsweet, and low-calorie food. At Wave I in-home interview, participants were also asked how many times in a week or during the past week they were involved in types of physical activity. At Wave IV, female participants reported pregnancies and birth outcomes. Multivariable linear regression analysis with survey weighting was used to predict birth weight and gestational age.
Results: There were no associations between reported food intake and birth outcomes. Girls who engaged in more episodes of active behavior had higher birth weights ($P < .01$), but hours of sedentary behavior was not associated with birth weight. Multivariable analysis also indicated a U-shaped association between BMI and birth weight (P for quadratic term = .01).
Conclusion: Adolescents who are more physically active before pregnancy have more positive birth outcomes as represented by birth weight.
Key Words: Adolescents, Birth weight, Gestational age, Preconception nutrition, Physical activity

Introduction

Preconception health has been increasingly recognized as a predictor of, and opportunity for improvement of, pregnancy outcomes.[1] Recommendations for preconception care usually include optimal nutrition and physical activity.[2,3] However, even among women who are actively planning pregnancy, nutritional intake is often below recommended daily allowances,[4–6] and at least 1 study found that the majority of women do not meet recommendations for physical activity, either.[5] The recommendations for preconception health behavior, while commonsense, have not been tested much for their relationship with birth outcomes such as low birth weight (LBW) and preterm birth (PTB).

A systematic review of periconceptional nutrition rated the quality of evidence for effects of preconceptional nutrition on birth weight and gestational age as low.[7] Preconceptional vitamin use was associated with a reduced risk of PTB and small for gestational age (SGA) in the Danish National Birth Cohort, but associations were generally stronger for early postconceptional use rather than preconception.[8] Almost all women who used vitamins preconceptionally also used them postconceptionally, making the independent effects difficult to determine.[8] A recent study reported that prenatal dietary and vitamin C supplement intake reduced associations between nitrosatable drug exposures and certain birth defects.[9] Studies of overall preconception diet, as opposed to supplements, are also few. Dietary patterns and nutrients have also been associated with success of assisted reproductive technology in some studies.[10] No relationship was found between prepregnancy diet (including fruit and vegetable intake, meat intake, fats, and cholesterol) and glucose intolerance during pregnancy in 1 study.[11]

Preconception physical activity is even less studied. In the HUNT study, prepregnancy leisure time physical exercise was not associated with overall birth weight.[12] However, women who reported no exercise were at a reduced risk of delivering a macrosomic (excessively large) infant, especially if they had higher body mass index (BMI).[12] Preconception physical activity has also been associated with a reduced risk of glucose intolerance during pregnancy.[11,13]

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The related factors of weight and adiposity have been linked to adverse birth outcomes. Malnourished and underweight women are at greater risk for LBW, SGA, and PTB.[7,14] On the other end, obese women are at greater risk for preterm birth, particularly when medically indicated by complications such as preeclampsia.[15] Obesity, especially with associated gestational diabetes, is associated with macrosomia in the infant.[16] There is some evidence that prepregnancy eating disorders are associated with preterm birth, low birth weight, and SGA,[14,17,18] even among those whose eating disorder occurred significantly before pregnancy.[17] This is likely partly due to lower prepregnancy BMI[19,20]; binge eating disorder is also sometimes associated with higher birth weights; there are higher BMIs in this group compared with other eating disorders.[21]

Compared with adult pregnancies, adolescent pregnancies have disproportionately high rates of negative birth outcomes, such as infant mortality,[22–24] stillbirth,[25] congenital anomalies,[26] PTB, and LBW.[27] However, potential determinants or risk indicators of birth outcomes, including preconception nutrition and physical activity, have been less studied in adolescent mothers compared with in adult mothers. Nutrition is of particular concern in adolescent mothers, who may still be growing themselves and who may have poor diet quality and limited nutritional knowledge.[28–30] Physical activity during adolescence also has positive effects on both physical and psychological well-being, such as reduced obesity and relieved symptoms of depression,[31,32] which are associated with better birth outcomes.[33,34] The purpose of the present study was to examine how maternal preconception nutrition and physical activity are related to birth outcomes among adolescent mothers. Our hypotheses were (1) adolescents who ate more fruits and vegetables would have higher birth weight and gestational age and (2) adolescents who performed more physical activity and were less sedentary would have a higher birth weight and gestational age.

Materials and Methods

Data

Data from Waves I, II, and IV of the National Longitudinal Study of Adolescent Health (Add Health) contractual dataset were used. Add Health is a prospective cohort study of a nationally representative sample of young persons enrolled in grades 7 through 12 in the 1994-1995 school year (Wave I).[35] Follow-up interviews were conducted in 1996 (Wave II), 2001 (Wave III), and 2007-2008 (Wave IV). Add Health used a multistage probability clustered sampling design to obtain its original Wave I sample. The first stage of sampling was a stratified, random sample of all public and private high schools in the United States. A middle school whose students largely attended the selected high school was also recruited from each participating community. In-school surveys were attempted with all students attending participating schools; a total of 90,118 were completed. In the second Wave I sampling stage, a sample of adolescents was drawn for in-depth in-home interviews, consisting of a random core sample plus selected special oversamples; a total of 20,745 interviews were conducted at this stage. At Wave II, most students (except Wave I seniors) were eligible for re-interview. At Wave IV, all respondents to the Wave I in-home interview were eligible for re-interview. A total of 15,701 interviews were conducted at Wave IV (80.3% response rate). Mean and median age at this interview was 28 (range 24-32). Sampling weights adjusted for both unequal probabilities of selection into the original sample and for loss to follow-up.

Our focus was on predictors of adolescent birth outcomes, so several exclusions were applied to the data set. First, we limited our analysis to females who participated in Wave IV, as that was the only wave by which all respondents had completed their teenage years and thus had complete data on teen births. Second, we limited our analysis to participants with valid sampling weights in order to make generalizations to the wider US population. Third, we considered only women whose first pregnancies occurred after Wave I, occurred during their adolescence, and ended with a singleton livebirth to ensure the temporal ordering of predictors and outcomes (n = 978). Finally, we limited to women with complete information on all covariates (n = 833) for analysis of Wave I predictors. There was no significant difference in any of the variables when comparing included (n = 833) versus excluded (n = 145) adolescents. For analyses of Wave II predictors, the data set was limited to births after Wave II (n = 756) and 572 girls had complete data on all covariates. Analyses comparing included (n = 572) versus excluded (n = 184) adolescents indicated no significant difference in any of the variables except for age at Wave I (14.98 versus 16.42 in included and excluded samples, respectively; $P < .001$).

Measures

Outcomes

At Wave IV, girls were asked about previous pregnancies and their outcomes. If they indicated they had given birth, they were asked “How much did the baby weigh at birth?” “Was [baby's name] born before or after [his/her] due date?” “How many weeks or days early/late was [baby's name] born?” This was subtracted from 40 weeks to calculate gestational age. Birth weight was examined in kilograms, and gestational age was examined in weeks.

Predictors

Nutrition. In Wave I in-home interview, girls were asked to recall their frequency of having 5 types of food on the previous day: milk/yogurt/cheese, fruit/fruit juice, vegetables, bread/cereal/pretzels/rice/pasta, and cookies/doughnuts/pie/cake. Response options were “0 = Didn't eat,” “1 = Ate once,” and “2 = Ate twice or more.” Responses were analyzed as continuous variables.

In Wave II in-home interviews, adolescents recalled their intake (Yes/No) on the previous day of 55 food and beverage items that represented 76 variables on consumption and types.[36] These 55 items were grouped into 3 categories based on a previous analysis: high-calorie sweet, high-calorie nonsweet, and low-calorie food.[37] High-calorie sweet category includes foods such as doughnuts, ice