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Food Matters: Food Insecurity among Pregnant Adolescents and Infant Birth Outcomes

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Food Matters: Food Insecurity Among Pregnant Adolescents and Infant Birth Outcomes

Lower birth weight and earlier gestational age – even within normal ranges – are associated with poor health outcomes in infancy,[1,2] childhood [3,4] and adulthood.[5,6] In the United States, reproductive health disparities have persisted or worsened over the past three decades, and compared to both developed and developing countries, prevalence of adverse birth outcomes are substantially higher.[7] Food and nutrition are critically important to support a healthy pregnancy, and impact preterm birth and low birth weight which are leading causes of infant morbidity and mortality.[8 9]

During pregnancy, women must have both an adequate quantity and quality of food. For example, they need certain vitamins and minerals for healthy fetal growth, and should eliminate foods that are unhealthy or unsafe (e.g., processed meats).[10] Food insecurity, defined as having limited or uncertain availability of nutritionally adequate foods,[11] prevents many women from meeting guidelines for healthy eating during pregnancy. Prior research suggests that food insecurity is associated with increased risk of low birth weight, certain birth defects, excess weight gain, gestational diabetes and other pregnancy complications.[13-16] However, to date, research on food insecurity and birth outcomes has been limited by reliance on cross-sectional data, focus on adults, and failure to identify the mechanisms by which food insecurity may impact birth outcomes. Specifically, mental health, including depressive symptoms and anxiety, as well as nutrition and weight gain may mediate the association between food insecurity and birth outcomes.

Food insecurity has been associated with depression and anxiety among mothers.[17-19] Pregnant women experiencing depressive symptoms are at risk for dysfunctional placentation and intrauterine growth restriction, which affect birth outcomes such as preterm birth.[20] Food insecurity also has been associated with poor quality dietary intake[21] and decreased nutritional status among women.[22,23] Nutritionally poor but energy dense foods (such as refined grains, sugary treats and salty snacks) are less expensive than vegetables and whole grains. Pregnant women have additional nutritional demands, and food insecurity makes meeting these demands difficult. Finally, girls and women living in food insecure households in the US are more likely to be overweight.[24] This is paradoxical to the notion that poor nutrition would be associated with underweight status pre-pregnancy and poor maternal weight gain during pregnancy. Together, poor nutrition and excess weight/weight gain

increase the risk for pregnancy complications such as gestational diabetes, preeclampsia and fetal macrosomia, which may lead to worse birth outcomes including shorter gestations and lower birth weights.[25-27]

Food insecurity tends to be cyclical, meaning that in many households, food insecurity waxes and wanes at different times of the year and month. Yet most prior research on food insecurity is cross-sectional and does not assess temporal variations in food insecurity. We extend the state of the science by assessing food insecurity at two time points during pregnancy to understand whether variations in food insecurity are associated with birth outcomes. We differentiate between temporary, acute food insecurity and sustained, chronic food insecurity. Study participants include young, urban women of color – a population disproportionately affected by food insecurity.[12]

The objectives of this study are to: (1) document prevalence of food insecurity among pregnant adolescents; (2) determine if food insecurity is associated with adverse birth outcomes (i.e., earlier gestational age, lower birth weight) among their newborns; and (3) examine whether depressive symptoms, anxiety, nutrition and/or weight gain mediate these associations. This study extends prior research by differentiating between acute and chronic food insecurity, examining the effects of food insecurity on birth outcomes in a unique sample of urban adolescents, and attempting to understand the underlying mechanisms driving this association. Results may have implications for inter-generational effects of food insecurity on pregnant adolescents and their children.

METHODS

Data for this paper are from a cluster randomized controlled trial (RCT) of group prenatal care at 14 community hospitals and health centers in New York City. Study sites were randomized to deliver group prenatal care (Centering Pregnancy Plus)[28,29] or standard individual prenatal care. Although these analyses draw on longitudinal data from the cluster randomized trial, they do not examine the effect of the intervention. Therefore, data were included from all participants with intervention group and site clustering controlled in all analyses.

PARTICIPANTS

Adolescents (ages 14-21) who attended prenatal care at one of the 14 participating clinical sites were referred by their provider or were approached by research staff to participate in the study between 2008 and 2011. To be eligible, women had to be at less than 24 weeks'

gestation, have no indications of a high-risk pregnancy, be English or Spanish speaking, and be willing to participate in a randomized controlled trial. Research staff explained the study to potential research participants and obtained informed consent.

There were 1,233 women enrolled in the study. Analyses for this paper were limited to women with birth outcomes data, singleton birth, those with no history of preterm birth, and women who answered food insecurity questions during interviews in both the second and third trimesters of pregnancy (n=881). Those included in the analyses were slightly younger [M(SD) = 18.61 (1.75) versus M(SD)=18.83 (1.68); t=1.99, p=.047], more likely to be employed [22.1% versus 16.2%; χ^2 (1)=5.37 p=.020] and more likely to be nulliparous [86.9% versus 79.0%; X^2(1)=11.61 p=.001] than those excluded.

PROCEDURES

Interviews were conducted at two time points during pregnancy: during the second trimester (14 to 24 weeks gestation, mean=19.35 weeks, SD=3.2), and third trimester (32 to 42 weeks gestation, mean=34.74 weeks, SD=2.7). Interviews were completed in English or Spanish using Audio-Handheld Assisted Personal Interview technology. Participants were paid $20 for each interview. Maternal and child medical records were systematically reviewed by trained research staff. Written informed consent was obtained by research assistants. Institutional Review Boards at Yale University and at affiliated clinical sites approved all procedures.

MEASURES

Primary Outcomes: Gestational Age and Birth Weight. Trained research staff abstracted gestational age and birth weight from labor and delivery logs at the participating hospitals and health centers. For missing data, self-report was supplemented from interviews. Self-report birth weight was highly correlated with birth weight recorded from labor and delivery logs (r = .94, p<.001).

Main predictor: Food Insecurity. To determine food insecurity status, participants answered one question taken from the Pregnancy Nutrition Questionnaire developed by the State of California Health and Human Services Agency, WIC Supplemental Nutrition Branch:[30] *Do you ever run out of money or food stamps to buy food?* Participants were split into three groups depending on how they answered this question at both time points. If participants answered “no” during both the second

and third trimesters of pregnancy, they were considered Food Secure. If they answered "yes" at one time point, they were considered Acute Food Insecure and if they answered "yes" at both time points, they were considered Chronic Food Insecure.

Depressive Symptoms. The Center for Epidemiologic Studies Depression Scale (CES-D)[31] was used to assess depressive symptoms during the third trimester of pregnancy. As in prior studies with pregnant women,[32] the psychophysiological items were dropped because pregnancy is often a cause of physical disturbances that resemble symptoms of depression (e.g., changes in appetite and sleep). The remaining 15 items reflect the frequency of affective components of depressed mood in the past week (e.g. feel depressed, feel lonely). Responses included: *less than 1 day (0), 1-2 days (1), 3-4 days (2) and 5-7 days (3)*. Responses were summed to create a composite score and was found to be reliable (Cronbach α = .86). The clinical cut off for the CES-D scale for depression is 16.

Anxiety. The Generalized Anxiety Disorder Scale (GAD-7)[33] was used to identify probable cases and measure severity of generalized anxiety disorder during the third trimester of pregnancy. This is a seven question scale and asks participates to rate the frequency with which they experienced various anxiety-related problems over the last two weeks. Responses ranged from 0 to 3 scale, with *0=not at all* and *3=nearly every day*. Responses were summed and the scale was found to be reliable (Cronbach α = .89).

Nutritional Quality. During the third trimester of pregnancy, participants answered a modified version of the REAP/WAVE (Rapid Eating and Activity Assessment, Weight Activity, Variety and Excess) [34,35] to assess nutritional quality. The measure consists of 11 questions and asks participants to indicate how often they skip breakfast, eat meals out, eat fried foods, chips, whole grain products, fruits and vegetables, add butter or margarine to foods, eat yogurt cheese or drink milk, eat sweets and drink regular soda. Responses included: *Never, 1-2 days, 3-4 days, 5-6 days and every day.* Items were scored such that higher nutrition scores indicate poorer nutrition, and were summed to create a composite scale. This scale was found to be moderately reliable (Cronbach α = .66)

Weight Gain. Weight gain during pregnancy was calculated based on weight recorded in participants' medical records. If weight was not available in the medical record, self-reported weight was used. Among participants who had both medical record and self-report weight data, responses were highly correlated ($r=0.84$, $p<.001$).

Socio-demographic Characteristics. Participants self-reported socio-demographic (age, race/ethnicity, country of origin, education status, employment status, source of financial support, housing security (defined as moving more than two times during pregnancy)[36], relationship status) and clinical characteristics (parity, drinking/smoking during pregnancy).

STATISTICAL ANALYSES

Following descriptive statistics, we explored differences in socio-demographic and clinical characteristics as well as mediating and outcome variables stratified by levels of food insecurity. Path analysis was then used to test whether depressive symptoms, anxiety, nutrition and/or weight gain mediated associations between food insecurity and gestational age and/or birth weight.[37] We examined these birth outcomes continuously given evidence suggesting that variations in birth weight, even within normal ranges, carry important implications for health outcomes across the lifespan.[1, 38] Unstandardized path coefficients enable interpretation of results in terms of grams for birth weight and days for gestational age, and thus were reported. Analyses compared adolescents who reported acute and chronic food insecurity compared to those who reported no food insecurity. We controlled for the effects of the study intervention and clustering by site as well as sociodemographic characteristics that differed between groups based on food insecurity status. We also controlled for pre-pregnancy body mass index given that recommended weight gain during pregnancy is contingent upon this[39]. We included paths between all control variables and all mediating and outcome variables. Bootstrapping was used to estimate the indirect effects of food insecurity on birth outcomes through the four different mediators. Analyses were conducted using SPSS v.19 (Armonk, NY) and mPlus v.6 for path analyses (Los Angeles, CA).

RESULTS

DESCRIPTION OF STUDY SAMPLE

Participant characteristics are presented in Table 1, stratified by food security status. Participants ranged in age from 14-21 years, with a mean age of 18.6. More than one-half of the adolescents included were Latina, and more than one-third were Black. Thirty-six percent were born outside of the United States. Most (86.9%) were nulliparous. Twenty-four percent of women reported depressive symptoms (CES-D>16). Twenty-nine percent reported mild anxiety, 11.5% reported moderate anxiety, and

7.7% reported severe anxiety (GAD-7 > 15). Mean gestational age was 274.4 (SD=14.2) days and mean birth weight of infants was 3197.1 (SD=527.9) grams; 7.9% (69) had low birth weight babies and 8.4% (74) had preterm babies.

It is most important to note that more than one-half of pregnant adolescents reported acute food insecurity (i.e., at one time during pregnancy, 26.1%) or chronic food insecurity (i.e., at both time points during pregnancy, 26.6%). Pregnant adolescents who were food secure were more likely to be financially self-sufficient, less likely to be housing insecure, and less likely to drink or smoke during pregnancy (all $p < 0.05$). They also reported lower levels of depressive symptoms, generalized anxiety and poorer nutritional quality of their diets (all $p < 0.05$).

Food Security and Birth Outcomes: Mediation Analyses

We evaluated a path model to examine the association between food insecurity and birth outcomes as mediated by depressive symptoms, anxiety and nutrition. Weight gain was not associated with any of the other mediators; therefore, we trimmed correlations between weight gain and the other mediators to acquire model fit statistics. The general pattern of results (i.e., significance level and direction of effects) remained the same for all other paths after trimming these correlations. The resulting model, shown in Figure 1, represented a strong fit for the data, $\chi^2(3)=1.99$, $p=0.58$; RMSEA= 0.00 (0.00-0.05), CFI=1.00.

The direct effects of acute and chronic food insecurity on gestational age and birth weight were non-significant. However, both acute and chronic food insecurity were associated with greater depressive symptoms and anxiety as well as poorer nutrition. Adolescents who experienced acute or chronic food insecurity experienced worse mental health and nutrition during pregnancy than those who were food secure. Of these three potential mediators, only depressive symptoms were associated with gestational age and birth weight, with greater depressive symptoms associated with lower birth weight and shorter gestational age. Finally, neither acute nor chronic food insecurity was associated with weight gain during pregnancy, yet weight gain was associated with both increased birth weight and longer gestational age. Therefore, weight gain was associated with birth outcomes, but did not mediate the association between food insecurity and birth outcomes.

Results of the bootstrapping analyses demonstrated that the indirect effect of acute food insecurity on birth weight via the mediator of depressive symptoms was marginally significant [*b(se)*= -14.34(8.00),

p=.07]. The indirect effect of chronic food insecurity on birth weight via the mediator of depressive symptoms was statistically significant [*b(se)*= -35.73 (15.69), *p*=.02]. Analyses further demonstrated that the indirect effect of chronic food insecurity on gestational age via the mediator of depressive symptoms was marginally significant [*b(se* = -0.83(0.44), *p*=.06]. No other indirect effects were statistically significant. Therefore, we conclude that depressive symptoms mediated the effect of acute and chronic food insecurity on birth weight, and the effect of chronic food insecurity on gestational age. Anxiety, nutrition, and weight gain did not act as mediators of associations between food insecurity and birth outcomes.

DISCUSSION

Approximately one-quarter of our sample of pregnant adolescents were chronically food insecure, reporting food insecurity during the second and third trimesters of pregnancy. An additional one-quarter were acutely food insecure, reporting food insecurity at one time point during pregnancy. This represents a striking proportion of adolescents in an urban setting affected by food insecurity during pregnancy, underscoring the importance of better understanding the effect of food insecurity on birth outcomes and the mechanisms underlying these associations. Chronic food insecurity was associated with both shorter gestational age and lower birth weight via the mediator of depressive symptoms. Acute food insecurity was associated with lower birth weight via the mediator of depressive symptoms. Food insecurity is related to these adverse birth outcomes, as well as to poor maternal mental health (depressive symptoms and anxiety) and health behaviors (nutrition).

These findings contribute to a growing body of research that suggests food insecurity during pregnancy has a significant impact on birth outcomes.[13-15] By differentiating between acute and chronic food insecurity, we demonstrate that even acute food insecurity is associated with adverse birth outcomes. This is consistent with other research which has shown that even marginal food insecurity has negative effects on health, and is therefore important to examine.[40] Depressive symptoms and stress during pregnancy have been shown to be a risk factor for adverse outcomes for mothers and babies.[41] Our findings extend prior research by identifying depressive symptoms as an important mediator in the association between food insecurity and birth outcomes.

LIMITATIONS, STRENGTHS AND FUTURE DIRECTIONS

There are several methodological limitations to address. First, we used only a single item to measure food insecurity. Though this is from a validated scale, as a single item it can be considered more of a "screening tool."[30] Nonetheless, we did find variation in response and food insecurity was associated with depression and other indicators as expected. Future research should utilize more robust measures of food insecurity and should examine the impact of food insecurity at different time periods before, during and after pregnancy. Although our unique sample of pregnant adolescents, mostly Latina and Black, limits the generalizability of the findings, it allows us to gain important insight into the associations between food insecurity and birth outcomes among a population at high risk for food insecurity and adverse birth outcomes.[42]

In contract, this study has several notable strengths. Using longitudinal data, we were able to test whether food insecurity reported during pregnancy was prospectively associated with birth outcomes. Moreover, we were able to test the mechanism underlying these associations. We tested four possible mediators and found that depressive symptoms were the most important mediator between food insecurity and birth outcomes for this sample of adolescents. Future research should continue to examine the role of depression and seek to identify other mediators that may be important in understanding this association and amenable to intervention.

CONCLUSION

Health care providers who treat adolescents should screen for food insecurity and depressive symptoms. The American Academy of Pediatrics recommends screening for food insecurity.[43] These recommendations should be extended to include screening during pregnancy. Providers must leverage clinical and community resources to connect those who are food insecure with increased access to high quality food. This study also highlighted depressive symptoms as a mediator of the relationship between food insecurity with gestational age and birth weight. Therefore, it is vital that women in this population are screened and treated for depression during the perinatal period. Shorter gestational ages and lower birth weight are associated with poorer infant health;[1,2] consequently, addressing these problems during pregnancy will increase the chances that children will be born healthier and with a better opportunity for good health across the developmental life cycle. Other research demonstrates that household food insecurity will continue to affect children's outcomes once they are born. Caregivers in households

struggling financially often have higher emotional distress and depressive symptoms, which adversely affects children's health.[44] This study highlights the importance of food insecurity for children's health – both among adolescent mothers and their offspring. Programs and policies should target these vulnerable children to stem the "multi-generational" effects of food insecurity. Further research should be conducted on the effects of food insecurity during pregnancy for both mothers and children. Longitudinal studies following vulnerable mothers and their children should also be conducted to understand the effects of food insecurity across the lifespan.

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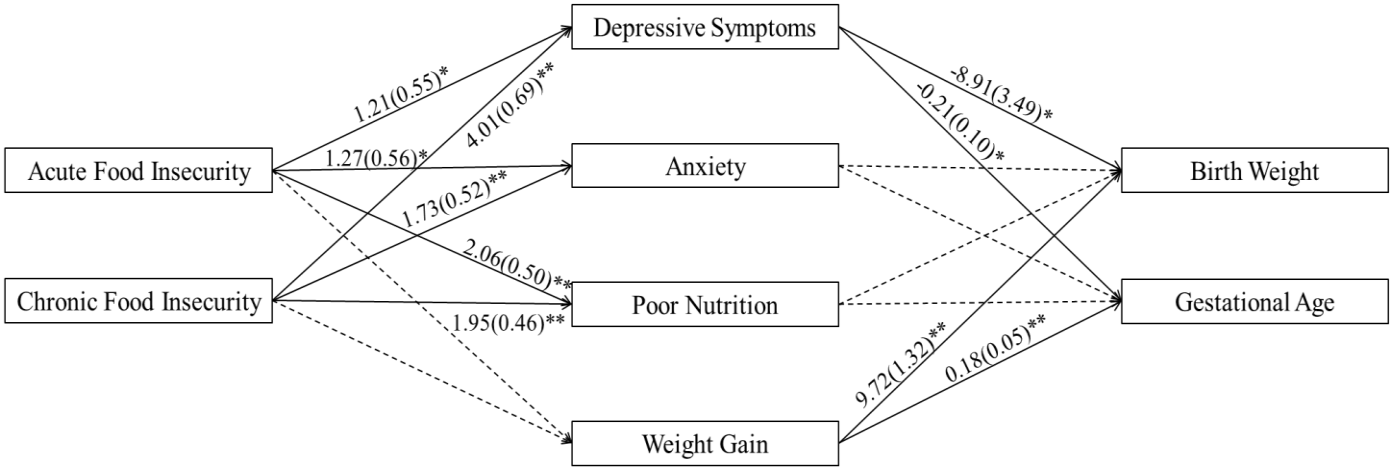
Table 1. Participant characteristics by level of food security

	Total Sample (N=881)	Food Secure (n=417)	Acute Food Insecurity (n=230)	Chronic Food Insecurity (n=234)	Chi-square or ANOVA
SOCIODEMOGRAPHIC CHARACTERISTICS; *% (n) , except age M (SD)*					
Age (years)	18.6 (1.7)	18.5 (1.8)	18.6 (1.8)	18.8 (1.6)	2.41^
Race Ethnicity					3.75
Latina	56.9 (501)	59.2 (247)	56.5 (130)	53.0 (124)	
Black, non-Latina	35.0 (308)	34.1 (142)	34.8 (80)	36.8 (86)	
White/other, non-Latina	8.2 (72)	6.7 (28)	8.7 (20)	10.3 (24)	
Born Outside of the US	36.5 (322)	35.5 (148)	32.6 (75)	42.3 (99)	5.09^
Enrolled in School	45.6 (400)	48.7 (202)	45.4 (104)	40.3 (94)	4.18
Employed	22.1(194)	21.4 (89)	21.1 (48)	24.5 (57)	1.00
Source of Financial Support					6.54
Self-support	32.3 (284)	29.0 (121)	31.9 (73)	38.8 (90)	
Other	67.7 (594)	71.0 (296)	68.1 (156)	61.2 (142)	
Housing Insecure	26.9 (232)	22.6 (93)	22.6 (52)	38.0 (87)	19.71***
Relationship Status					
Single-never married	58.9 (505)	56.3 (227)	61.0 (136)	61.5 (142)	2.13
Other	41.1 (352)	43.7 (176)	39.0 (87)	38.5 (89)	
CLINICAL CHARACTERISTICS; *% (n) or M (SD)*					
Nulliparous	86.9 (735)	86.8 (349)	89.2(198)	84.7 (188)	1.98
Pre-Pregnancy BMI	24.4 (6.3)	24.1 (4.8)	24.58 (6.27)	29.94 (6.6)	1.44
BMI Change (T1 to T2)	3.1 (4.8)	3.0 (4.8)	3.15 (5.04)	3.07 (4.6)	.068
Drinking during Pregnancy	8.0 (70)	5.5 (23)	11.3 (26)	9.0 (21)	7.20*
Smoking during Pregnancy	4.8 (42)	1.4 (6)	6.1 (14)	9.5 (22)	22.32***
MEDIATING MECHANISMS; *M (SD)*					
Depressive Symptoms	10.9 (8.1)	9.3 (7.4)	11.1 (7.8)	13.6 (8.8)	22.83***
Generalized Anxiety	5.5 (5.1)	4.6 (4.5)	6.0 (5.5)	6.6 (5.3)	12.97***
Nutritional Quality	13.8 (5.4)	16.1 (6.1)	17.7 (6.1)	17.7 (5.7)	5.52**
Weight Gain	32.2 (17.4)	31.9 (16.9)	31.7 (16.6)	33.3 (18.9)	0.62
BIRTH OUTCOMES; *M (SD)*					
Gestational Age (days)	274.4 (14.2)	275.0 (11.6)	275.6 (11.0)	272.2 (20.0)	4.04*
Birth Weight (grams)	3197.1 (527.9)	3213.6 (532.5)	3197.9 (447.0)	3167.2 (591.1)	0.570

*** p<0.001; ** p<0.01; * p<0.05; ^ p<0.10

Figure 1. Path model of relationship between food insecurity and birth weight and gestational age



Note: $^{**}p \leq .001$, $^{*}p \leq .05$, $\dagger p \leq .10$; Analysis controlled for the effects of the intervention, pre-pregnancy BMI, mother's age, born outside the US, financial support, living situation, housing insecurity, smoking during pregnancy, and drinking during pregnancy on all mediators and birth outcomes.