Summary Points

- Adverse birth outcomes appear to be triggered by multiple, interacting biological and environmental factors. However, maternal factors (social and demographic) do not fully explain the rates of preterm birth, low birthweight, and small-for-gestational age in Virginia. A growing body of research points out that there is an association between living in a food desert, or an area with identified food insecurity, and adverse health outcomes.
- This study used birth certificate data linked to Map the Meal Gap locality-level food insecurity. Findings suggest that increases in locality-level food insecurity were associated with an increased odds of having an adverse birth outcome.
- Future research should examine how access to existing supplemental food programs and dietary behavior modifies this relationship.

LOCALITY-LEVEL FOOD INSECURITY AND ADVERSE BIRTH OUTCOMES IN VIRGINIA: AN ANALYSIS OF BIRTH CERTIFICATE DATA, 2016-2020

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Background

Adverse birth outcomes, such as preterm birth and low birthweight, are associated with high morbidity and mortality. As of 2020, 9.6% of live births in Virginia were preterm (<37 weeks gestation), 8.4% of all live infants in Virginia in 2019 were considered low birthweight (< 2,500 grams at birth), and 36% of infant deaths were preterm-related.

Rather than having one cause, adverse birth outcomes appear to be triggered by multiple, interacting biological and environmental factors, including maternal age, smoking, obesity, multiple births and birth spacing among others. However, maternal sociodemographic factors do not fully explain these rates and require additional exploration of social determinants of health.

A growing body of research points out an association between living in a food desert, or an area with identified food insecurity (defined as a household-level economic and social condition of limited or uncertain access to adequate food), and adverse health outcomes.

According to the Life Course Health Development theory, early exposures to stressors during pregnancy can affect health outcomes in adulthood. As food insecurity may be one type of stressor, this study sought to explore the association between locality-level food insecurity and adverse birth outcomes, defined as preterm birth, low birthweight, and small-for-gestational age (SGA).

Methods

This study used birth certificate data of all live births to resident women during the 2016-2020 period in Virginia and who had complete information on both exposure and outcome of interest.

The exposure was locality-level food insecurity data in Virginia (2015-2019) from [Feeding America's Map the Meal Gap](). Map the Meal Gap analyzes food insecurity and its closely linked indicators (poverty, unemployment, homeownership, disability prevalence, etc.) at the state level, generating coefficient estimates that are used for locality calculations to estimate food insecurity rates for individuals and children at the locality-level. Locality-level food insecurity prevalence estimates occurring in the year prior to the index birth were used to account for exposures potentially occurring prior to and during pregnancy.

Our primary outcomes of interest were preterm delivery (born <37 weeks), low birthweight (born <2500 g), and small-for-gestational age (birthweight <10th percentile) occurring during 2016-2020, and derived from Virginia birth certificate data. These outcomes were combined as a composite outcome of adverse birth outcomes. Demographic information, along with data on the adverse birth outcomes were tabulated.

For our analysis, Map the Meal Gap data were linked to Virginia birth certificate data based on the mother's locality of residence. Hierarchical logistic regression was used to model the relationship between locality-level food insecurity and adverse birth outcomes. Confounders were included in a tiered fashion. The first model of confounders accounted for the demographic factors (age, race/ethnicity, BMI, marital status, and health region). The second model included income-based confounders (education and health insurance type). The third model included health behavior-based confounders (pre-pregnancy smoking, pre-existing hypertension, and pre-existing diabetes). Because of the uncertainty of timing and potential to be on the causal pathway, WIC status and Kotelchuck index of prenatal care adequacy were included in a final model. Sensitivity analyses were conducted to explore the associations with each outcome separately.

Results

493,788 women and birthing persons were included in the study during the 2016-2020 period. The median food insecurity prevalence during this period was 8.6%. Figure 1 depicts the food insecurity prevalence by locality during this time period. During 2016-2020, 7.5% of women and birthing persons had a preterm birth, 6.3% had a low birthweight, and 9.5% had an infant born SGA. Figure 2 presents the prevalence of adverse birth outcomes by locality. In the analytic sample, the majority of birthing persons were between 25-34 years old, non-Hispanic white, married, and had at least a high school diploma. Birthing persons who had an adverse birth outcome were more likely to be living in a locality with higher median food insecurity (9.3%) compared with birthing persons who did not have an adverse birth outcome (8.5%). Birthing persons with an adverse birth outcome were also more likely to be on extreme opposites of childbearing age, weight, Medicaid status, WIC use, smoking, and presence of a pre-existing chronic condition compared with those who did not experience adverse birth outcomes.

Results from the unadjusted hierarchical model (Table 1) showed that the odds ratio for developing an adverse birth outcome was 3.39 (95% CI: 2.25, 5.12). After adjusting for all main sociodemographic confounders and health-related behaviors and conditions (Model 3), the odds remained significant (OR 1.97 [95%CI: 1.38, 2.80]). These results suggest that for every percent increase in locality-level food insecurity there is nearly a 2-fold increase in odds of developing an adverse birth outcome.

Results remained significant with the addition of WIC participation and Kotelchuck Index. Sensitivity analyses exploring each outcome separately revealed a stronger association in the odds of delivering a SGA infant.

Figure 1. Geographical distribution of food insecurity prevalence, Virginia, 2015-2019

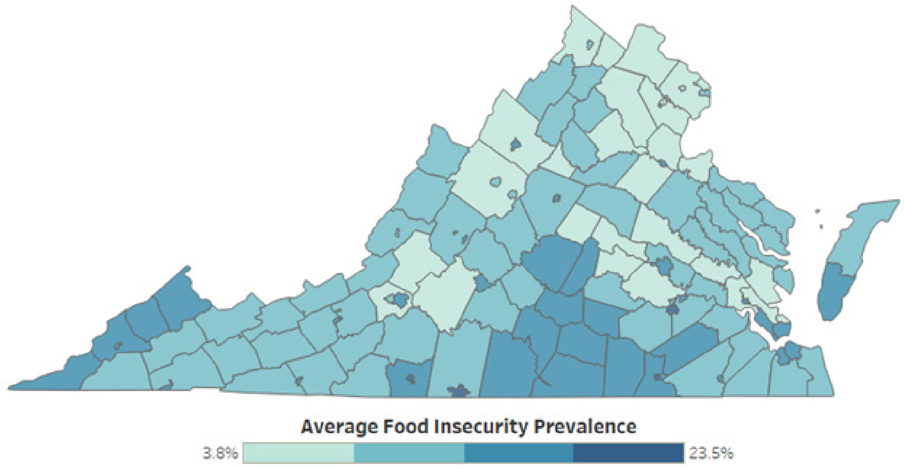

Figure 2. Geographical distribution of adverse birth outcomes, Virginia, 2016-2020

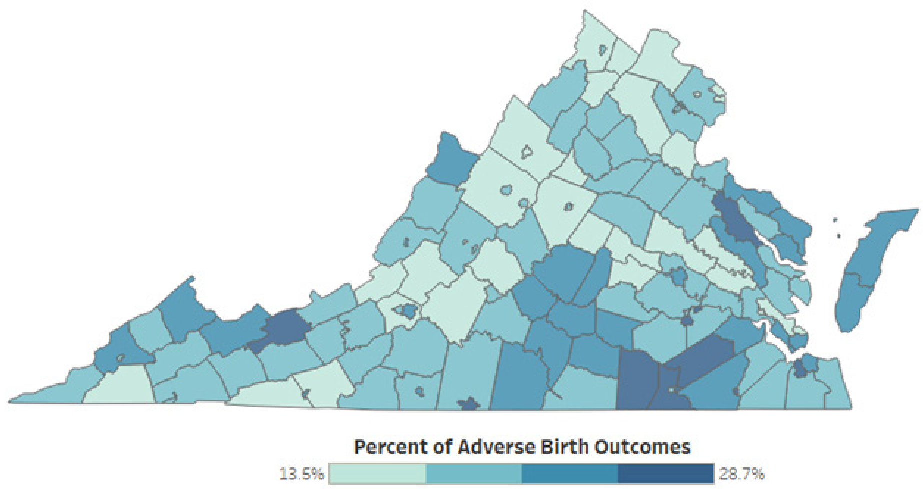

Table 1. Unadjusted and adjusted odds ratios (aOR) and 95% confidence intervals

	aOR (95% CI)
Unadjusted	3.39 (2.25, 5.12)
Adjusted	
Model 1	1.83 (1.21, 2.78)
Model 2	2.01 (1.37, 2.93)
Model 3	1.97 (1.38, 2.80)
Model 4	2.17 (1.51, 3.11)

Discussion

In this study, the prevalence of food insecurity and adverse birth outcomes varied by locality. Findings suggested that the higher the food insecurity prevalence, the higher the odds of delivering a low birthweight, preterm, or small-for-gestational age infant. This effect was strongest when looking at SGA, which is a more accurate indicator of fetal growth, since many low birthweight babies are also born preterm.

It is well established that food-insecure areas are intertwined with a plethora of adverse social, economic and health outcomes. This study identified that birthing persons residing within such an area were more likely to experience an adverse birth outcome, compared with birthing persons residing in a locality of lower food insecurity. These findings are congruent with the previous body of knowledge describing the relationship between food insecurity and experiencing adverse health outcomes; however, limited studies have occurred particularly among the pregnant population. This study has limitations to note. First, there may be some unobserved locality- and individual-level confounders in the association, such as income, segregation, access to grocery stores or medical facilities, transportation, or cumulative exposure to residing in food insecure environments. However, income was accounted for by incorporating insurance and WIC participation, which are strong predictors of household income. Dietary intake data were not available in the population as well, and demonstrating whether differences in diet mediate the association would be important to examine in future research. Longevity of exposure to living in a food-insecure area could not be ascertained, but locality-level food security data in the year prior to birth was used. The available food insecurity data does not include the period after the COVID-19 pandemic, which could have further exacerbated the effects of living in a food-insecure area. Future research would be necessary to examine the effects of the pandemic on food insecurity.

Strengths should also be noted. This study is among the first to demonstrate the risk of having an adverse birth outcome associated with living in a food-insecure locality, and is unique in linking Map the Meal Gap data to birth certificate data. Because the study included all Virginia residents, these results are generalizable to the Commonwealth of Virginia, but may not be generalizable to other states that may have different racial and ethnic distributions than Virginia.

The recent White House Summit on Hunger, Nutrition, and Health emphasized that the issue of food insecurity is an important one to explore, because food insecurity not only affects adults and children, but pregnant populations as well. With the Life Course perspective in mind, limiting exposure to food insecurity during pregnancy may be warranted from a public health perspective, in order to reduce the effects it may have on the future health of newborns.

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