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Good Friends and Good Neighbors:

Social Capital and Food Insecurity in Families with Newborns

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Conflicts of Interest and Prior Presentations

Dr. Flower previously reviewed abstracts for Patient Centered Outcomes Research Institute funded studies unrelated to this study. The authors have no other conflicts of interest to disclose. An earlier version of this work was presented as an oral abstract at the 2023 Academic Pediatric Association Region IV conference and the 2023 Pediatric Academic Societies conference.

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Data Sharing Statement

This secondary analysis utilized data from the ongoing Greenlight Plus Trial which was registered as "Greenlight Plus Study: Approaches to Early Childhood Obesity Prevention" NCT04042467 [https://clinicaltrials.gov/study/NCT04042467] on August 2, 2019. Deidentified individual participant data will not be made available until the Greenlight Plus Trial is complete.

Objective To examine the association between social capital and household food insecurity among US families with newborns.

Study design This cross-sectional analysis used enrollment data from 881 newborn-caregiver dyads at six geographically-diverse US academic sites enrolled in the Greenlight Plus Trial, a comparative effectiveness trial to prevent childhood obesity. Ordinal proportional-odds models were used to characterize the associations of two self-reported measures of social capital: 1) caregiver social support and 2) neighborhood social cohesion, with household food insecurity after controlling for sociodemographic characteristics.

Results Among 881 newborn-caregiver dyads (49% Hispanic, 23% non-Hispanic white, 17% non-Hispanic Black; 49% with annual household income <$50,000), food security was high for 75%, marginal for 9%, low for 11% and very low for 4%. In covariate-adjusted analyses, caregivers with a low social support score of 18 had five times the odds (aOR=5.03 95%CI=3.28-7.74) of greater food insecurity compared with caregivers with a high social support score of 30. Caregivers with a low neighborhood social cohesion score of 10 had nearly three times the odds (aOR=2.87 95%CI 1.61-5.11) of greater food insecurity compared with caregivers with a high neighborhood social cohesion score of 20. These associations remained robust when both social capital measures were included in one model.

Conclusions Caregiver social support and neighborhood social cohesion each appear to be inversely associated with food insecurity among US families with newborns. Longitudinal research is needed to determine the directionality of these relationships and whether improving social capital for families with young children reduces household food insecurity.

Abbreviations and Acronyms

BMI: Body Mass Index

WIC: Special Supplemental Nutrition Program for Women, Infants, and Children

OR: Odds Ratio

CI: Confidence Interval

IQR: Interquartile Range

Household food insecurity, defined as when a household's "ability to acquire adequate food is limited by a lack of money and other resources," affected over one in six US households with children in 2022.[1] Food insecurity is associated with numerous adverse health outcomes in children including increased body mass index (BMI),[2] anemia,[3] abnormal early childhood development, [4,5] academic problems,[4,6–8] and mental and behavioral health problems among both children[4,7,9,10] and their parents.[9,11] Although poverty is a well-established risk factor for food insecurity,[12] the other resources that affect food security status have been less thoroughly explored. Social resources may represent some of these other resources and could be novel targets for interventions to prevent or reduce food insecurity and its deleterious impacts on the health of children and families.

Social capital, defined in pediatrics as "the benefits that a child receives from social relationships"[13] is a positive social driver of health. The relationship between social capital measures and food insecurity is underexplored in families with infants. It is important to study social capital in the newborn period, as it represents a time when social networks are especially relied upon, experience significant change,[14] and may be more modifiable than at other life stages. It is a time of frequent contact with the healthcare system, which provides the opportunity for connection to food security resources.[13]

Two fundamental components of social capital are social support and social cohesion.[13] Social support has been defined as "support accessible to an individual through social ties to other individuals, groups, and the larger community"[15] and has at least four domains: emotional support, informational support, social companionship, and instrumental support. Greater social support has been linked with improved health outcomes in adults with chronic conditions.[16–18] Evidence supports the buffering hypothesis that social support can attenuate

the potentially deleterious effects of stressors on health,[19] and specific neurobiological pathways that mediate these relationships have been proposed.[20] Among US adults, there are conflicting results regarding the potential association between social support and food insecurity. One analysis found a significant, inverse association between social support and food insecurity,[21] yet another found no significant association.[22] Among families with young children, there are very limited data on the potential relationship between social support and food insecurity. One analysis found that greater instrumental social support defined as "the provision of financial aid, material resources, and needed services"[19] was protective against food insecurity among families with young children,[23] but data are lacking regarding other domains of social support in this population.

Social cohesion measured at multiple levels, including the neighborhood level, is defined as "the strength of a group to which a person belongs,"[13] and has also been linked to health outcomes [24] by both direct and indirect sharing of resources, through the sharing of information.[25] Multiple studies have found associations between higher levels of neighborhood social cohesion and lower food insecurity among families with children. [23,26–29] However, these studies did not include families with children under age two[23,27,28] or did not include data on child ages,[26,29] and most were geographically limited to a single city[27,28] or state.[26]

Therefore, data are lacking regarding the potential associations between social capital and food insecurity for families with very young children. It is important to study this relationship in racially and ethnically diverse populations due to the demonstrated significance of race in social capital constructs, including neighborhood social cohesion,[30] and the well-established racial and ethnic inequities in food insecurity among families with children.[1]

We sought to examine the association between household food insecurity and two measures of social capital, 1) caregiver social support and 2) neighborhood social cohesion, after controlling for income and other sociodemographic factors in a large, diverse cohort of families with newborns. We hypothesized that there would be an inverse relationship between each measure of social capital and food insecurity among families with newborns.

Methods

Participants

This secondary data analysis used baseline data from newborns and their caregivers enrolled in the Greenlight Plus Trial, a previously described comparative effectiveness trial to prevent childhood obesity (registered as NCT04042467).[31] The Vanderbilt University Medical Center Review Board served as the single IRB for this trial. Review committees at each participating site also approved this study, and all participants provided written informed consent to participate. English- and Spanish-speaking caregivers of newborns were recruited from six US academic medical center sites: Duke University, New York University, Stanford University, University of Miami, University of North Carolina, and Vanderbilt University Medical Center. Caregivers completed baseline questionnaires between October 2019 and August 2021. Families were excluded if their infant was greater than 21 days old, had very low birthweight <1500g, gestational age <34 weeks at birth, weight less than the third percentile at enrollment, or had a chronic medical problem that could affect weight gain.[31]

Measures

Caregiver social support was measured using the ENRICHD Social Support Instrument, the six-item form of a validated scale for an individual's self-reported social support.[32,33] The

respondent is asked how frequently someone is available to provide them with various types of social support, such as how often “is there someone available to you to give you good advice about a problem.” Responses range from “none of the time” to “all of the time.” Overall scores range from 6-30; a higher score indicates greater social support. [33]

Neighborhood social cohesion was measured using the social cohesion scale, a five-item form of a validated scale for an individual’s self-reported social cohesion in the area within a twenty-minute walk from their home (ie, their neighborhood).[34,35] The respondent is asked how much they agree or disagree with statements about the neighborhood, such as “people around here are willing to help their neighbors.” Responses range from “strongly disagree” to “strongly agree.” Overall scores range from 5-25, and the scale was designed so that a lower score indicates greater neighborhood social cohesion.[34] For clarity in this analysis, the scale was reverse coded such that a higher score indicates greater neighborhood social cohesion.

Food insecurity was measured using the validated six-item short form of the US Household Food Security Survey.[36] Scores range from 0-6; higher scores indicate greater food insecurity. A score of 0 indicates high food security, 1 indicates marginal food security, 2-4 indicates low food security, and 5-6 indicates very low food security.

Seven variables measured at baseline were included in our analysis to control potential confounding. Household income was assessed via self-report and categorized as follows: <$20,000, $20,000 to $49,999, $50,000 to $99,999, $100,000 or more, and Other (including "Don't know/Not sure" and "Prefer not to answer"). Household WIC status was determined through self-report and categorized as "Yes" (if the mother and/or child was enrolled in or received WIC food/formula) or "No" (if neither the mother nor the child was enrolled in or received WIC food/formula). The number of children in the household was self-reported and

categorized as 1, 2, or >3. The number of adults in the household was also self-reported and categorized as 1, 2, or >3. Caregiver race and ethnicity was self-reported and categorized as "Hispanic," "Black, non-Hispanic," "White, non-Hispanic," or "Other, non-Hispanic." Caregiver education was self-reported and categorized as "Less than high school graduate," "High school graduate, but less than college degree," or "College degree or higher." The study site was recorded in the study database as Duke, Miami, NYU, Stanford, UNC, or Vanderbilt.

Statistical Analysis

We summarized the baseline characteristics using the median and interquartile range for continuous variables, and proportions and counts for categorical variables. Cronbach's alpha was used to assess the internal consistency and reliability of caregiver social support, neighborhood social cohesion, and food insecurity scores. Spearman rank correlations were used to characterize the strength of the bivariate relationships between neighborhood social cohesion, caregiver social support, and food insecurity.

Our outcome variable, the food insecurity score, is an ordinal variable ranging from 0 to 6. To fully assess the covariate-adjusted relationship between neighborhood social cohesion and caregiver social support with food insecurity, we used ordinal proportional-odds logistic regression models. Ordinal proportional-odds models [37,38] are one type of ordinal logistic regression model wherein a proportional odds assumption is imposed on the risk factor associations with the outcome. The proportional odds assumption forces the odds ratio (OR) association measure to remain constant across all levels of the outcome variable. In our case, this means that the OR associated with a change in a risk factor is the same across level of the food insecurity outcome. For example, as the food insecurity score ranges from 0 to 6, the odds ratio remains constant for outcome odds of 1-6 versus 0, 2-6 versus 0-1, 3-6 versus 0-2, etc. Even

when the proportional odds assumption is violated, estimated OR most often provide meaningful and parsimonious measures of association.

We fit three models to examine associations with food insecurity: one that included caregiver social support and covariates as independent variables, a second that included neighborhood social cohesion and covariates as independent variables, and a third that included caregiver social support, neighborhood cohesion, and covariates as independent variables. Model covariates were prespecified based on existing literature on social capital and food insecurity, as well as the expertise of the author team, to minimize confounding bias.

The estimated OR characterize the strength of association between risk factors and outcome variables, and we report 95% confidence intervals (CI) to capture uncertainty. Odds ratios greater than one are consistent with higher food insecurity, and OR less than one are consistent with lower food insecurity. Because caregiver social support and neighborhood social cohesion are continuous variables, and to avoid assuming a linear relationship between these independent variables and food insecurity, we decided *a priori* to use restricted cubic spline functions. A brief description of these functions has been provided in the supplemental material.[39] To display the associations graphically we calculated OR with 95% CI for a series of values of caregiver social support and neighborhood social cohesion in comparison with the mode for each measure.

Out of 900 caregiver-infant dyads enrolled in the Greenlight Plus study, only 19 were excluded from this analysis due to missing food insecurity scores. Missing covariates, including three caregiver social support scores and 30 neighborhood social cohesion scores, were multiply imputed with chained equations using predictive mean matching implemented through the

aregImpute function from the R package Hmisc.[40] One hundred distinct imputations were constructed and estimates from the imputation-specific analyses were combined with Rubin's Rule.[41] Overall p-values, corresponding to the global test for the association between each of the independent variables and the outcome, were calculated using the Wald test in the adjusted models. A two-sided p-value less than 0.05 was considered statistically significant. All analyses were conducted with R version 4.2.3.[42]

Results

A total of 881 caregiver-infant dyads (98% of the Greenlight Plus sample) were included in the analysis. Approximately half of the caregivers, 49%, identified as Hispanic or Latino; 23% identified as non-Hispanic white; 17% identified as non-Hispanic Black. Forty-nine percent of caregivers reported an annual household income less than $50,000, and 21% reported educational attainment less than high school graduate. In 63% of families, there was participation in WIC by the mother, infant, or both. Demographic and baseline characteristics of the participants are shown in **Table I**.

The median caregiver social support score was 29 (IQR: 26-30), and the median neighborhood social cohesion score was 18 (IQR: 15-20). Seventy-five percent of families reported high food security, 9% reported marginal food security, 11% reported low food security, and 4% reported very low food security. There was high internal consistency of all three measurement scales with Cronbach's alpha of 0.85 (95%CI= 0.83-0.86) for caregiver social support, 0.80 (95%CI= 0.77-0.82) for neighborhood social cohesion, and 0.86 (95%CI= 0.84-0.87) for food insecurity. In unadjusted analyses, food insecurity was significantly inversely correlated with caregiver social support (Spearman's rho= -0.32, p value<0.0001) and

neighborhood social cohesion (Spearman's rho= -0.21, p value <0.0001), and caregiver social support was significantly positively correlated with neighborhood social cohesion (Spearman's rho= 0.28, p value <0.0001).

Caregiver social support and neighborhood social cohesion were each highly associated with household food insecurity. In covariate adjusted analyses, caregiver social support and neighborhood social cohesion were significantly associated with the food insecurity score at the two-sided 0.05 significance level. Graphical results of OR for a series of values compared with the mode are shown in **Figure 1a** for caregiver social support and **Figure 1b** for neighborhood social cohesion and are also reported in supplemental Table I and supplemental Table 2 in the supplemental material.

As shown in **Figure 1a**, caregivers with a low caregiver social support score of 18 had approximately five times the odds of greater food insecurity compared with caregivers with a high caregiver social support score of 30 (aOR=5.03 with 95%CI= 3.28-7.74). After further adjustment for neighborhood social cohesion, the relationship remained strong (aOR=4.50 with 95%CI= 2.90-6.98). As shown in **Figure 1b**, caregivers with a low neighborhood social cohesion score of 10 had nearly three times the odds of greater food insecurity compared with those with a high neighborhood social cohesion score of 20 (aOR=2.87 with 95% CI 1.61-5.11) after controlling for the covariates listed above, and the curve is approximately linear with respect to the natural log scale of the OR. The association remained significant after further adjustment for caregiver social support (aOR=2.15 with 95% CI=1.18-3.93). Additional OR are presented in supplemental Table 1 and supplemental Table 2. Graphical representation of the aOR of all covariates for all three models are included in Supplemental Figure 1, Supplemental Figure 2, and Supplemental figure 3 of the supplemental material.

Discussion

In this diverse sample of nearly 900 families with newborns from six US academic medical centers, we found support for our hypothesis that caregiver social support and neighborhood social cohesion are each inversely associated with food insecurity after controlling for sociodemographic characteristics. This supports the larger understanding that social resources are significantly associated with food security status for families with young children. We found a weak, positive correlation between caregiver social support and neighborhood social cohesion in our unadjusted analysis and found that the relationship between each of these components of social capital and food insecurity remained statistically significant even when including the other component in the fully adjusted model. This supports the understanding that each of these measures is associated with food insecurity and that the two measures should not be inappropriately conflated.

Our results provide new insights into the relationship between social support and food insecurity among families with young children. Although social support has not been consistently associated with food insecurity among US adults in prior literature,[21,22] this analysis demonstrates a significant association between caregiver social support and household food insecurity among US families with young children. One prior study of families with children showed an inverse association between one domain of social support, instrumental social support, and food insecurity.[23] The present analysis adds to the evidence base by finding a significant inverse association between a broader measure of social support and food insecurity. This result suggests that other domains of social support, such as emotional support and

informational support, may also be associated with food insecurity for families with young children.

Our study adds to the existing literature on neighborhood social cohesion and food insecurity among families with children by analyzing this relationship in a novel population, families with newborns, in a geographically, racially, and ethnically diverse sample. It is important to study families with newborns because this life period involves significant social network changes[14] and frequent contact with the healthcare system, which may provide additional opportunities for connection to relevant neighborhood resources.[13] These results also highlight the importance of public policies that serve to support social networks and neighborhood social cohesion for families with young children.

Although lower caregiver social support and neighborhood social cohesion were each associated with greater food insecurity in our sample, the adjusted models differed in that the curve for the caregiver social support model was not linear, while the curve for the neighborhood social cohesion model was approximately linear. The fact that the lower odds of greater food insecurity were only observed at the highest levels of caregiver social support in our analysis calls into question whether interventions to enhance caregiver social support could be an effective way to decrease food insecurity. The approximately linear curve demonstrating the relationship between neighborhood social cohesion and the odds of greater food insecurity in our analysis suggests that even small increases in neighborhood social cohesion could have significant impacts on food insecurity or vice versa. These results lead us to hypothesize that social interventions at the neighborhood level may be more effective at reducing food insecurity, compared with interventions at the individual or household level. This hypothesis is consistent with the conclusions of similar research in families with older children,[23] but longitudinal data

on both measures of social capital and food insecurity among families with young children are needed to test this hypothesis. It is also possible that the results of this analysis are related to an undefined shared upstream causal path.

Further study is warranted regarding the mechanisms by which social capital may decrease food insecurity. A systematic review of adaptive strategies used by families with food insecurity revealed numerous social strategies including borrowing food from friends and family, bringing children to relatives' homes for meals, shopping with friends and family for bulk items, receiving cash assistance from friends or family, and living with extended family or friends.[43] The review found limited evidence that these strategies may differ by race and ethnicity, but further research is needed to determine whether it is best to culturally tailor social capital interventions, especially for populations facing disproportionally high rates of food insecurity.

Our study has some important limitations. First, the cross-sectional design leaves us unable to determine causality or directionality of the associations between our variables of interest. With this design, our variables of interest could be subject to a shared upstream causal path that we were not able to identify. The observational study design also raises concern for potential residual confounding, although we diligently sought to control for the relevant confounding factors. Second, the social capital measures used in this study were validated among US adults who were older, more male, and less racially and ethnically diverse than our sample,[32,35] which may limit their validity in our sample. In addition, our sample's social capital scores were concentrated at higher values. As a result, the generalizability of our findings may be limited to populations with higher social capital. Another limitation of our neighborhood social cohesion scale is the lack of a codified threshold for lower neighborhood social cohesion.

The exclusion of families with language preferences other than English or Spanish and of infants with very low birthweight limits the generalizability of these findings to families with these characteristics. Furthermore, although data support the bidirectional relationship between parental mental health and food insecurity for families with children,[44] we did not include a measure of parental mental health in our model. This was because the available mental health measure in our study, the nine-item patient health questionnaire (PHQ-9), has been shown to have a low positive predictive value, and therefore a high false positive rate, among mothers with newborns less than one month old.[45] Fortunately, the ongoing Greenlight Plus trial[46] will survey caregiver social support, neighborhood social cohesion, food insecurity, and caregiver mental health at multiple timepoints among this sample over the newborns' first two years of life to allow for longitudinal analyses of these associations.

Despite these limitations, our study has important strengths. In addition to the novel population of families with newborns, the strengths of this study include the large, diverse sample of English- and Spanish- speaking families from six sites across the US in which approximately half of caregivers identified as Hispanic or Latino. These data help to address an important gap in the literature on social drivers associated with food insecurity among Hispanic/Latinx households with children under age three, which is a growing population in the US with a disproportionately high rate of food insecurity compared with other ethnic groups.[47] We also use a validated measure of food insecurity that captures the severity of this phenomenon, rather than dichotomizing food insecurity as present or absent.

Future research should evaluate measures of social capital among families with young children longitudinally, including caregiver social support and neighborhood social cohesion. Data are needed regarding the modifiability of these measures, as interventions that successfully

increase social support have only been demonstrated in adults[48] and data are lacking on interventions that increase neighborhood social cohesion. Ultimately, additional research is needed to determine whether enhancing caregiver social support or neighborhood social cohesion might represent novel means of preventing or addressing food insecurity for families with young children, in addition to connecting families with nutritional resources.

In conclusion, two measures of social capital, caregiver social support and neighborhood social cohesion, are each inversely associated with food insecurity among US families with newborns in this study. Longitudinal data are needed to determine the directionality of these associations and to determine the modifiability of social capital measures, as they may represent targets to prevent or address food insecurity among families with young children.

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Table I. Characteristics of study participants (N=881)

Variables	**N**	
Infant age (days)	881	4 [3,6]
Caregiver income	881	
< $20,000		210 (24%)
$20,000 to $49,999		221 (25%)
$50,000 to $99,999		99 (11%)
$100,000 or more		122 (14%)
Other (don't know/not sure or prefer not to answer)		229 (26%)
Caregiver education	881	
Less than high school graduate		185 (21%)
High school graduate, but less than a college degree		379 (43%)
College degree or higher		317 (36%)
Caregiver race and ethnicity	881	
Black, non-Hispanic		150 (17%)
Hispanic/Latino		431 (49%)
White, non-Hispanic		207 (23%)
Other, non-Hispanic		93 (11%)
Caregiver preferred spoken language	881	
English		581 (66%)
Spanish		300 (34%)
Number of adults at household	881	
1		95 (11%)
2		564 (64%)
≥3		222 (25%)
Number of children at household	881	
1		337 (38%)
2		261 (30%)
≥3		283 (32%)
Household WIC status	881	
Enrolled		553 (63%)
Not enrolled		328 (37%)
Food insecurity score	881	
High food security (0)		665 (75%)
Marginal food security (1)		80 (9%)
Low food security (2-4)		97 (11%)
Very low food security (5-6)		39 (4%)
Caregiver social support	878	29 [26, 30]
Neighborhood social cohesion	851	18 [15, 20]

Values are n (%) for categorical variables and median [25th to 75th percentiles] for continuous variables. Food insecurity scores range from 0-6; higher scores indicate greater food insecurity.

WIC = Women, Infants & Children Program

Figure 1a: The Association Between Caregiver Social Support and Food Insecurity.

Adjusted OR and 95% CI from the fully adjusted ordinal proportional-odds regression model of food insecurity (US Household Food Security Survey score) on caregiver social support (ENRICHD Social Support Instrument score). Values are compared with the reference mode value of caregiver social support=30. The Y-axis is natural log-transformed. The overall p value was calculated with the Wald test. This p-value corresponds to the global test for the association between the caregiver social support and the outcome. Because we used a restricted cubic spline with three knots to model caregiver social support, the Wald test is a two degrees of freedom test, one for the linear component of the association and one for the non-linear component. Under the null hypothesis, coefficients corresponding to linear and non-linear associations are both zero and under the alternative hypothesis, at least one of them is non-zero.

Figure 1b: The Association Between Neighborhood Social Cohesion and Food Insecurity.

Adjusted OR and 95% CI from the fully adjusted ordinal proportional-odds regression model of food insecurity (US Household Food Security Survey score) on neighborhood social cohesion (social cohesion scale score). Values are compared with the reference, mode value of neighborhood social cohesion=20. The Y-axis is natural log-transformed. The overall p value was calculated with the Wald test. This p-value corresponds to the global test for the association between the social cohesion and the outcome. Because we used a restricted cubic spline with three knots to model social cohesion, the Wald test is a two degrees of freedom test, one for the linear component of the association and one for the non-linear component. Under the null hypothesis, coefficients corresponding to linear and non-linear associations are both zero and under the alternative hypothesis, at least one of them is non-zero.