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Association of Food Insecurity with Mental Health Outcomes in Parents and Children: A Systematic Review

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Abstract

Background: Food insecurity affects 13.7 million U.S. households and is linked to poor mental health. Families shield children from food insecurity by sacrificing their nutritional needs, suggesting parents and children experience food insecurity differentially.

Objective: To identify the associations of food insecurity and mental health outcomes in parents and children

Data Sources: PubMed, Embase, Web of Science, and PsycInfo

Study Eligibility Criteria: We included original research published in English from January 1990 – June 2020 that examined associations between food insecurity and mental health in children or parents/guardians in the U.S.

Study Appraisal and Synthesis Methods: Two reviewers screened studies for inclusion. Data extraction was completed by one reviewer and checked by a second. Bias and confounding were assessed using the Agency for Healthcare Research and Quality RTI Item Bank. Studies were synthesized qualitatively, grouped by mental health outcome, and patterns were assessed. Meta-analyses were not performed due to high variability between studies.

Results: We included 108 studies, assessing 250,553 parents and 203,822 children in total. Most studies showed a significant association between food insecurity and parental depression, anxiety, and stress, and between food insecurity and child depression, externalizing/internalizing behaviors, and hyperactivity.

Limitations: Most studies were cross-sectional and many were medium- or high-risk for bias or confounding.

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Declarations of Interest: none

Conclusions and Implications of Key Findings: Food insecurity is significantly associated with various mental health outcomes in both parents and children. The rising prevalence of food insecurity and mental health problems make it imperative that effective public health and policy interventions address both problems.

Keywords

Food insecurity; mental health; depression; anxiety; parents

INTRODUCTION

Food insecurity, defined as disrupted eating patterns or reduced quality of diet due to an inability to obtain adequate, nutritious food, is a major public health problem in the United States (U.S.).[1] The U.S. Department of Agriculture (USDA) estimates that 13.7 million U.S. households had food insecurity in 2019, and over half of these households include children.[2] Food insecurity is associated with numerous poor health outcomes,[3–7] and a growing body of evidence links food insecurity to poor mental health outcomes.[8–11] It is hypothesized that this connection is related to increased psychosocial stress and decreased intake of macronutrients important to emotional regulation.[12,13]

Research emphasizes the importance of mental health in overall well-being.[14,15] While adults commonly suffer from depression and anxiety, children incur an additional risk of developing hyperactivity and externalizing/internalizing problems.[16] Developing these disorders in childhood is a risk factor for experiencing mental health disorders as an adult. Similarly, parental depression predicts the development of mental health disorders in children.[17–19]

Children are often protected from substantially reduced quality and quantity of food by federal food supplement initiatives or parents/guardians who sacrifice their nutrition for the child's.[20–23] Therefore, parents and children may differentially experience food insecurity and subsequent mental health outcomes. Additionally, there is little research analyzing how the severity or duration of food insecurity impacts mental health outcomes, making it difficult to create an overall understanding of these variables.

To fill this gap in literature, this systematic review aims to evaluate the associations between food insecurity and mental health outcomes in parents and children. The objectives are to identify the direction and magnitude of the association between food insecurity and mental health in parents and in children, to understand if children's mental health is spared in exchange for worse parental mental health, and to identify the role of severity and duration of food insecurity in mental health outcomes.

METHODS

This systematic review was conducted and reported per PRISMA (preferred reporting items for systematic reviews) guidelines. The protocol was registered with PROSPERO (CRD42020196178), the international prospective registry for systematic reviews.[24]

Search Strategy

We searched four electronic databases (PubMed, PsycInfo, Embase, and Web of Science) for the terms food insecurity, food insufficiency, food supply, food poverty, food hardship, or hunger. These terms were cross-searched with terms for various mental health outcomes identified through the Medical Subject Heading database (Table 1). We included studies conducted in the U.S. that were published in English from January 1, 1990 through June 2020. The full search strategy is available in Supplemental 1.

Eligibility Criteria

Search results were compiled and duplicates were removed using Covidence.[25] Two of three investigators (K.S.C, S.C.M, K.K.P.) screened titles and abstracts (Inter-rater Reliability Cohen's Kappa ≥0.70). Abstracts were excluded if they were not original research, investigated animal subjects, or did not report an assessment of both food insecurity and a mental health outcome. Two authors (K.S.C with S.C.M, E.C, or N.J.C.) then independently reviewed manuscripts of the remaining articles (Cohen's Kappa ≥0.80). Studies were included if they assessed the association of food insecurity with a mental health outcome in adults with dependent children or in children 18 years old or younger. A third and fourth author (C.L.B with K.M. or D.P.) resolved discrepancies. The study selection process is presented in Figure 1.

Data Extraction

Data extraction forms were created in Covidence, piloted by multiple investigators, and adjusted as needed. Extracted data included: study design, sample size, sample demographics, definition and measure of food insecurity (e.g. USDA Household Food Security Survey Module, Hunger Vital Sign), mental health outcome (e.g. depression, anxiety), measure assessing mental health outcome (e.g. Patient Health Questionnare-9), and relationship of food insecurity to the mental health outcome via odds ratios, relative risks, relative risk ratios, and logistic regressions with their respective confidence intervals and statistical significance. The duration and severity of food insecurity was extracted when provided. Covariates for each analysis were extracted as well. Sample demographics that were extracted included, but were not limited to, age, sex, race, ethnicity, language spoken, household income, insurance status, and education level. In studies that divided their results by other demographics factors (such as rural vs. urban environment) those important demographic dividers were also extracted so results could be reported with the appropriate context. We also noted if a study used nationally representative data given that their results might be better extrapolated to recognize patterns across the United States. Data extraction was performed by one investigator (S.C.M., E.C., K.K.P, or N.J.C.) and checked by a second (K.S.C.). Discrepancies were reviewed by a third author (C.L.B.).

Study-Quality Assessment

Two investigators (K.S.C., and S.C.M., E.C., K.K.P, or N.J.C.) independently determined risk of bias and confounding. Discrepancies were reviewed by a third author (C.L.B.). We utilized the Agency for Healthcare Research and Quality Research Triangle Institute (RTI) Item Bank to assess risk of bias and confounding.[26] The risk of bias assessment reviews

the selection of participants, differences between study groups, length and loss to follow up, selection of primary outcomes, and believability of results. In addition, bias that may affect the cumulative evidence was considered. Risk of bias was operationalized by total score with a score of zero indicating “low-risk,” a score of one indicating “medium-risk,” and a score of two or more, or the presence of a fatal flaw, indicating “high-risk.” The risk of confounding assessment reviews validity and reliability of measures as well as the attempt to balance the allocation between groups. For risk of confounding, scores were similarly operationalized by total score with a score of zero indicating “low-risk,” a score of one indicating “medium-risk,” and a score of two or more, or presence of a fatal flaw, indicating “high-risk.”

Qualitative Analysis

Studies were grouped by mental health outcome and patterns were assessed. We compared whether studies used validated vs. non-validated measures for both food insecurity and the mental health outcome. We then compared results between studies based on a variety of factors such as study design, food insecurity factors (severity, duration, persistence vs transient nature) and sample demographics (age, sex, race, ethnicity, etc.). This allowed for a qualitative assessment of the overarching patterns, and then for a more detailed analysis to understand if those patterns persisted for various demographic groups. Studies used diverse measures for both food insecurity and mental health outcomes, leading to high variability between studies. This limited our ability to combine mental health outcome data for meta-analysis.

RESULTS

Study Characteristics

The electronic database search yielded 5335 articles. Duplicates were removed and 5180 abstracts were screened. Of these, 4630 abstracts were excluded, and the remaining 550 full-text articles were assessed for eligibility. One hundred and eight articles met inclusion criteria and were included in the qualitative review (Fig. 1). All studies were observational: 56 cross-sectional, 49 prospective cohort, 2 retrospective cohort, and 1 case-control. Studies surveyed parents only (n=61), children only (n=30), or parents and children (n=17). Study characteristics are presented in Table 2.

Food Insecurity

Food insecurity was defined using 10 validated and eight non-validated measures. Most studies (n=84) measured food insecurity at the household level, while 11 studies used a parent-level measure and 18 studies assessed food insecurity at the child level. The majority of studies (n=83) utilized a form of the USDA Household Food Security Survey Module. Studies commonly dichotomized the scale as “food insecurity” or “no food insecurity,” or utilized the USDA categories of food security (FS) (high, marginal, low, or very low).[1] Of the 24 studies that utilized nationally representative data, the prevalence of food insecurity was as high as 25%.[30] Non-validated measures tended to estimate a higher prevalence of food insecurity.

Mental Health Outcomes

The majority of studies evaluated the relationship between food insecurity and symptoms of depression, anxiety, externalizing and internalizing behaviors (directing problematic energy outward and towards oneself, respectively), hyperactivity, and stress.[133131,132] Additional studies evaluated the relationship between food insecurity and aggression, substance use, eating disorders, suicidality, obsessive-compulsive disorder, and post-traumatic stress disorder. Qualitative analysis for all mental health outcomes is presented in Supplemental Table 2.

Depression

Seventy-four studies assessed food insecurity with symptoms of depression (62 parent studies, 14 child studies). Depression was defined using 21 unique measures. There was a statistically significant association between food insecurity and depressive symptoms in 59 parent and 10 child studies. For parents, depressive symptoms and food insecurity were associated in urban[31,83] and rural populations.[39,40,48,52,57,74,103] The connection between food insecurity and depressive symptoms persisted in mothers of older children,[57,127] younger children,[57,59,80,98,99,122,127,134,135] and pregnant women.[62,109,110]

For children, significant correlations were seen between food insecurity and depression among children 2-17 years old. Notably, the studies with the greatest strength of evidence (large sample size combined with low risk for bias and low risk for confounding) also demonstrated a statistically significant association between food insecurity and depressive symptoms in children.[92,121,129] One study reported a stronger correlation between food insecurity and symptoms of depression in younger children than older children.[117] Food insecurity was associated with increased odds of suicide attempt in a nationally representative group of 15-year-olds and a group of Hispanic teens.[60,136] Longitudinal studies demonstrated that food insecurity at age five years was associated with depressive symptoms throughout childhood[134] and at age 15 years.[63] Depression in adolescence was also strongly correlated with food insecurity in adulthood,[120] and conversely, adults with depression were more likely to have experienced childhood food insecurity compared to their non-depressed counterparts.[45] Three studies failed to demonstrate a statistically significant association between food insecurity and depressive symptoms in children. These studies included a nationally representative sample of 15-16-year-olds[29] and a sample of Hispanic youth.[102]

Anxiety

Seventeen studies assessed food insecurity with symptoms of anxiety (eight parent, ten child studies). Anxiety was defined using 13 unique measures, most of which were validated. Food insecurity was significantly associated with anxiety symptoms in seven parent studies. Food insecurity in a child in the home was the most consistent and impactful predictor of parental anxiety, when compared to household- and parent-level food insecurity.[32,33]

Food insecurity was associated with anxiety symptoms in six child studies. Of the studies with the greatest strength of evidence, Hatem et al. demonstrated that food insecurity at five years of life is associated with increased symptoms of anxiety at age 15 years[63]

and McLaughlin et al. (2012) found significantly increased odds of anxiety symptoms in children with FI.[92] Three of the four studies that failed to demonstrate a statistically significant interaction between food insecurity and anxiety, including one study with high strength of evidence, interviewed majority Hispanic children[8,102,107]. Both marginal food security and risk of hunger were associated with increased anxiety,[86,134] and more intense food insecurity correlated with more intense symptoms of anxiety in children.[127] Longitudinal data revealed that childhood food insecurity impacts future anxiety.[63,111,137]

Externalizing Behaviors

Twenty-one studies evaluated food insecurity with externalizing behaviors in children. Four unique measures defined externalizing behaviors. Sixteen studies found a statistically significant relationship between food insecurity and externalizing behaviors. Of the two studies in this category with the highest strength of evidence, one found that transitions into and out of food insecurity were associated with increased externalizing behaviors and one did not find a statistically significant association between food insecurity and externalizing behaviors.[55,73]

Internalizing Behaviors

Thirteen studies assessed food insecurity and internalizing behaviors in children, and most, including those with the strongest strength of evidence, found a statistically significant association between these variables (n=10). All studies without statistically significant associations between food insecurity and internalizing (n=3) surveyed majority non-Hispanic White populations, and two reported an average child age of 6-7 years old.[55,57,58]

Hyperactivity

Twelve studies assessed food insecurity with hyperactivity in children. Nine studies found a statistically significant correlation between food insecurity and hyperactivity. The majority of children surveyed were younger than 10 years old.

Stress

Twelve studies assessed stress with food insecurity in parents. Five parent studies found a statistically significant relationship between food insecurity and stress.

Risk of Bias in Studies

Sixty-nine studies were low-risk for bias and 57 were low-risk for confounding (Table 3). Lack of adjusted analysis was the most common reason for confounding. Precision of studies varied greatly as sample sizes ranged from 29[90] to 36,145.[44]

DISCUSSION

This systematic review revealed that food insecurity is associated with a variety of mental health outcomes in both parents and children. A majority of studies demonstrated a statistically significant relationship between food insecurity and symptoms of depression, anxiety, and stress in parents. In children, food insecurity had a statistically significant

association with symptoms of depression, externalizing behaviors, internalizing behaviors, and hyperactivity in a majority of studies.

Depression

Our study demonstrated that food insecurity and symptoms of depression are intimately connected. This association persisted through various races, ethnicities, education levels, and geographic locations, but certain demographic groups were more affected than others. Food insecurity was associated with more than double the odds of depression for non-Hispanic Black mothers[28,42,115,133] and with double or nearly double the odds of depression in Hispanic mothers,[8,72,91] while the association was weaker for majority non-Hispanic White populations. It is well known that non-Hispanic Black and Hispanic families are impacted by food insecurity at greater rates than non-Hispanic White families.[138] Our review also reports that among families with food insecurity, non-Hispanic Black and Hispanic families are impacted by poor mental health at a greater rate. These findings were also reported by Dush (2019) when reviewing adolescent food insecurity and behaviors.[139] Discrimination and structural racism are gaining recognition as significant contributors to racial disparity in health outcomes and likely contribute to our results.[140] Differential rates of unemployment, incarceration, disability, and poverty among racial groups all contribute to the disparate rates of food insecurity.[140] Racial/ethnic discrimination predicts both emergence of food insecurity and depression, and the synergistic effect may explain why racial/ethnic minority families with food insecurity have worse mental health outcomes.[141]

For children, there was a striking connection between food insecurity and suicidality. Two studies revealed that food insecurity was associated with more than double the odds that a youth will attempt suicide. One study in our review surveyed a sample of Hispanic teens and found that food insecurity was related to increased odds of a suicide attempt more for boys than girls.[60] To our knowledge, this is the first review to collate studies associating suicidality with food insecurity in children. The rate of suicide attempts continues to rise, and the rate for Hispanic boys is increasing far more rapidly than that of the general population.[142] It is critical that healthcare providers screen for suicidality in at-risk populations, including those experiencing food insecurity.

Food insecurity also exhibited a dose-dependent relationship with mental health outcomes. Child food insecurity is considered the most severe form of food insecurity because parents typically attempt to shield their children from the effects of food insecurity.[2] Child food insecurity was associated with more severe depression in parents than parent- or household-level FI.[33,84] Marginal food security and low food security were associated with symptoms of depression, but to a lesser degree than food insecurity and very low food security, respectively.[56,105] Similarly, the duration and continuity of food insecurity appears to impact psychologic outcomes. Persistent food insecurity was associated with increased odds of depression significantly more than discontinuous food insecurity, while those with discontinuous food insecurity did not have significantly different depression than those who never had food insecurity.[61] Recurrent food insecurity, compared to one episode of food insecurity, had a stronger association with depression for parents.[55] This review, therefore, confirms that the intensity and frequency of food insecurity impacts mental health outcomes.

These factors must be evaluated for a complete understanding of a family's risk for mental health disorders.

Food insecurity and depression have a positive reinforcing relationship: food insecurity was related to concurrent depression and future depression, and depression was associated with future food insecurity. Several studies demonstrated that parents and children with symptoms of depression are more likely to maintain food insecurity, or fall into food insecurity, compared to acquire food security.[79,94,143] There are various suggested mechanisms for this cyclical relationship. Food insecurity and malnutrition may heighten biological responses to emotions such as stress.[144] A lack of macronutrient diversity can also impact the substrates available to construct neurotransmitters critical for regulating mood.[12,13] Similarly, poor iron intake due to food insecurity may alter brain development in children and have lasting effects on neuropsychiatric regulation.[145] Iron deficiency anemia is also independently associated with depression and may connect food insecurity with maternal depression.[146] Depression also limits employment opportunities, which may contribute to the development or persistence of food insecurity.[143] It is likely that both biological and psychosocial mechanisms contribute to the connection between food insecurity and depression.

It is reasonable to wonder if relieving food insecurity will also relieve negative mental health effects. Jacknowitz et al. (2015) found that transitions into and out of food insecurity and depression were correlated.[75] Still, children who experience food insecurity are more likely to suffer from mental health problems later in life, regardless of their food security status in adulthood.[45] More research must be dedicated to understanding the effect of treating food insecurity on changes in mental health.

Anxiety

Anxiety is less clearly associated with food insecurity. Fewer studies measured symptoms of anxiety, and while most parent studies found a statistically significant relationship between food insecurity and anxiety, this was only true in a little more than half of child studies. These results are in contrast to those of Myers (2020), who reports that food insecurity is positively correlated with anxiety in adult and adolescent populations across the globe.[147] The relationship between food insecurity and anxiety symptoms may depend on the race/ethnicity of the population. Our review revealed that anxiety and food insecurity were significantly correlated in non-Hispanic White populations, but the relationship was less consistent in majority Hispanic populations.[8,102] This may be due to under-diagnosis of anxiety in Hispanic populations since standardized measures inadequately capture variances in cultural comprehension of anxiety.[148] Statistical significance did not depend on the definition or prevalence of anxiety in a given study. The relationship between food insecurity and symptoms of anxiety in children may be less consistent than that of parents due to shielding and because child anxiety is better assessed through externalizing/internalizing behaviors.[149]

Externalizing and Internalizing Behaviors, Hyperactivity

Age, duration and intensity of food insecurity, and sex influenced the relationship between food insecurity and externalizing and internalizing behaviors in children. In several studies, food insecurity was associated with increased odds of externalizing behaviors in toddlers and preschool-aged children, but not in school-aged children.[49,57,59,78] Nonetheless, Fernandez et al. (2018) found that food insecurity influenced rule-breaking behaviors in 9-year-olds and food insecurity was associated with hyperactivity in children less than ten years old.[51] A connection between food insecurity and internalizing behaviors was found in both preschool- and school-aged children.[117,127] The differing prevalence of externalizing and internalizing problem behaviors in these age groups at baseline may contribute to this effect.[149,150] Our findings corroborate those of Shankar et al. (2017), who reported that food insecurity was associated with poor child behavior and academic performance.[151] We also found that persistent food insecurity affected externalizing and internalizing behaviors more than transient food insecurity.[58,82,118] Similar to other mental health outcomes, severe food insecurity had a stronger association with behavioral problems, including hyperactivity, than moderate food insecurity.[84,95,134]

The relationship between food insecurity and internalizing behaviors may be related to poor diet quality. O'Neil et al. (2014) found in their review that poor diet quality was associated with worse internalizing disorders in children, although many included studies did not account for activity level or socioeconomic status, which may also contribute to internalizing behaviors.[152] Recognizing the impact of food insecurity on child behavior is imperative because mental health disorders are more likely to present as behavioral changes in younger populations. Additionally, mental health problems are more likely to be unrecognized in children of lower socioeconomic status.[153] Taken together, healthcare workers screening for food insecurity should subsequently consider adding mental health and behavioral screens for children with household food insecurity.

Stress

Food insecurity is a risk factor for chronic diseases such as diabetes, hypertension, and obesity. Research suggests this is because food insecurity acts as a chronic stressor, increasing inflammation in the body.[154] Interestingly, less than half of stress studies in our review supported a significant association between stress and food insecurity. A different mechanism, therefore, may connect food insecurity and chronic disease. Notably, the studies included in this review assessed psychological stress rather than biological measures of stress, such as cortisol. Nearly all studies surveyed only low-income families, suggesting that income may moderate the relationship. In contrast to our review, Pourmetabbed et al (2020) found that food insecurity increased stress in men and women in North America.[155] It is notable that the aforementioned review assessed studies of all adult participants and not exclusively parents, reflecting that parents indeed may experience food insecurity differentially from the general population.

Limitations

All studies in this review were observational, limiting our ability to assign causality between food insecurity and mental health outcomes. Food insecurity and mental health parameters

were typically collected from the same individual, leading to shared method variance. Additionally, food insecurity and all mental health outcomes were defined using various validated and non-validated measures, and were assessed in a myriad of sub-populations, making it difficult to compare results and draw overarching conclusions. While we intended to compare the impact of food insecurity on mental health in children and in parents, few studies assessed the same mental health outcome in both parents and children, which limited our ability to understand how food insecurity in a home differentially impacts family members. The cumulative evidence in this review is also limited by potential publication bias, the risk of selective reporting within studies, and missing confidence intervals from some included studies.

CONCLUSIONS

The findings of this systematic review highlight the inexplicable link between food insecurity and mental health in parents and children. There is a need for policy and public health interventions that address both issues.[156] Both populations are especially vulnerable to the impact of food insecurity given parents' responsibility of caring for dependents and children's developing behavior and thought patterns. Policy or public health approaches could include increasing the benefit amount or reducing the administrative burden for accessing nutrition subsidies, such as the Supplemental Nutrition Assistance Program (SNAP) or the Special Supplemental Nutrition Assistance Program for Women, Infants, and Children (WIC). Both SNAP and WIC reduce food insecurity, and there is a growing body of evidence showing these programs could improve health outcomes.[157,158] Another approach could be providing income subsidies or universal basic income, such as through the Child Tax Credit. There is increasing evidence that providing basic income may improve health, particularly mental health.[159] Given the rise in both food insecurity and mental health problems during the COVID-19 pandemic, it is more important now than ever to develop public health and policy interventions that identify and address food insecurity and mental health sequelae.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What this Systematic Review Adds

- This review consolidates existing literature examining the associations of food insecurity with mental health problems
- Food insecurity is associated with depression and anxiety in parents and with depression, externalizing/internalizing behaviors, and hyperactivity in children
- Greater food insecurity duration and intensity are associated with worse mental health outcomes

How to Use this Systematic Review

- To identify where further research is needed to examine if mitigating food insecurity improves mental health outcomes
- To serve as a reference when developing clinical screening and intervention programs for food insecurity and mental health problems
- To serve as a reference when developing public health and policy interventions that identify and address food insecurity and mental health sequelae

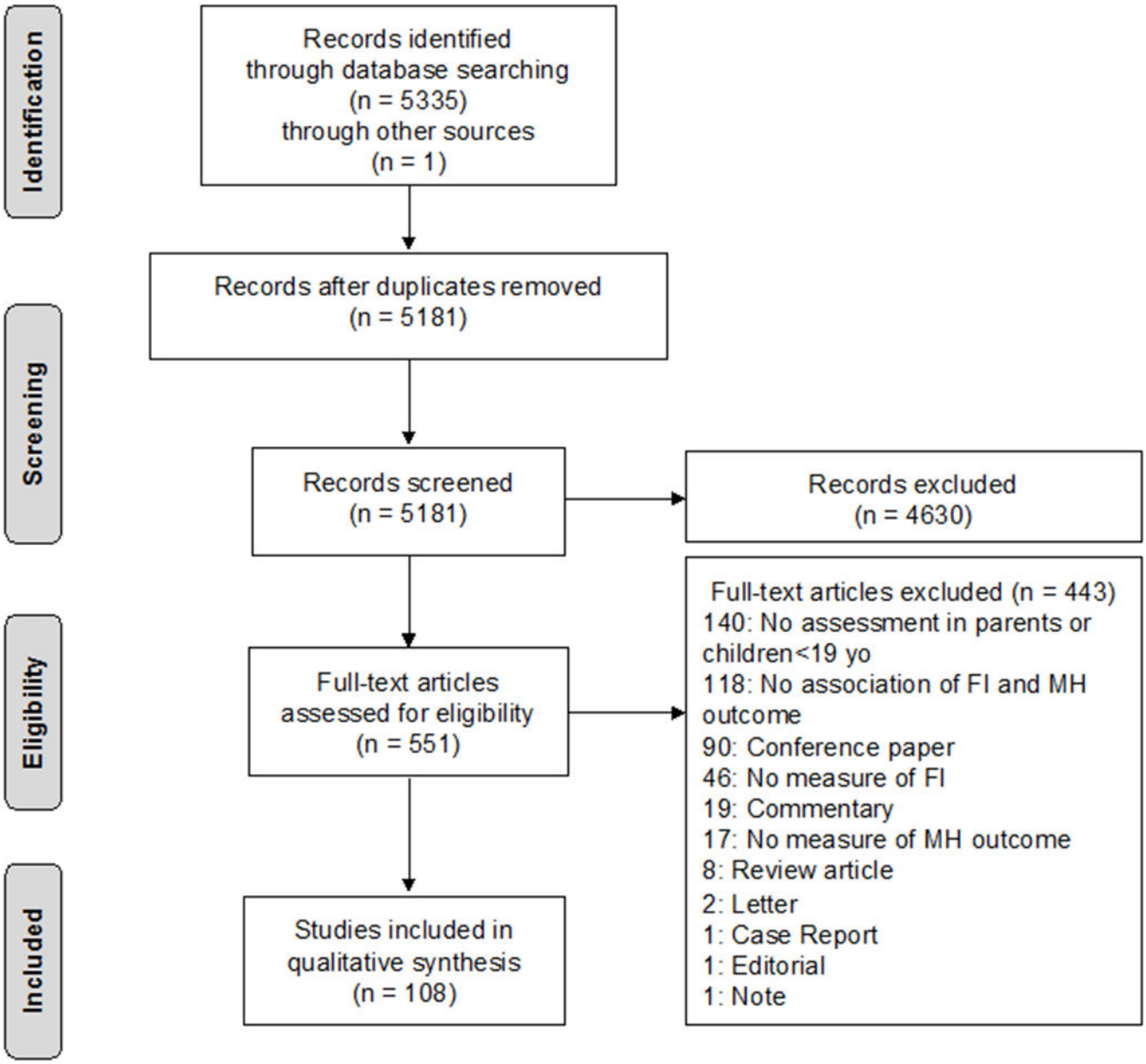

Figure 1:
PRISMA Flow Diagram

Table 1:

Search strategy for PubMed database

Number	Searches
1[a]	"Food supply" or "food insecurity" or "food security" or "food insufficiency" or "food sufficiency" or "food hardship" or "food poverty" or "hunger"
2[b]	"Anxiety Disorders" [MeSH] or "Mood Disorders" [MeSH] or "Obsessive-Compulsive Disorder" [MeSH] or "Phobic Disorders" [MeSH] or "Bipolar and Related Disorders" [MeSH] or "Neurodevelopmental Disorders" [MeSH] or "Disruptive Behavior Disorders" [MeSH] or "Child Development Disorders, Pervasive" [MeSH] or "Personality Disorders" [MeSH] or "Schizophrenia Spectrum and Other Psychotic Disorders" [MeSH] or "Substance-Related Disorders" [MeSH] or "Trauma and Stressor Related Disorders" [MeSH] or "Behavioral Symptoms" [MeSH]
3	1 and 2
4	Editorial or comment or letter
5	3 NOT 4
6	Date published: January 1, 1990 to June 5, 2020
7	5 and 6
8	Language: English
9	7 and 8

[a]Food insecurity terms also included variations of the terms listed.

[b]The current table includes the MeSH database terms that were included in the search strategy. The search strategy also included individual terms within each category (Available in Supplemental Table 1).

Table 2:

Study Characteristics

Author and Publication Year	Population	Sample Size	Study Design	Sex, % Female	Age [a]	Race
Adynski 2019 [27]	Low-income mothers	Stress: 842; Depression: 845; Anxiety:846	Prospective Cohort	100%	25.68 (5.76)	African American (AA) 53.8%; Hispanic (H) 24.2%; White (W) 22%
Ajrouch 2010 [28]	AA women in a high-poverty	736 Mothers	Cross-sectional	100%	30.8 (SE 0.3)	AA 100%
Alaimo 2002 [29]	NHANES for 15-16 yr olds	754 Adolescents	Cross-sectional	49.30%	15: 46.8% 16: 53.2%	W 66.7%; AA 15.4%; Mexican-American 7.8%
Ashiabi 2007 [30]	Families with a child 6-11 yrs old	9,645 Parent-child dyads	Cross-sectional	Parent 81.9%; Child 51.25%	Parents: 37.19 (7.61) Children: 8.39 (1.72)	W 69.12%; H 16.81%; AA 14.07%
Austin 2017 [31]	Urban, low-income women	296 Mothers	Cross-sectional	100%	33.2 (10.6)	AA 56.5%; H 23.3%; W/Other 14.5%
Becker 2017 [32]	Food pantry clients in TX	503 Adults	Cross-sectional	76.50%	< 25: 2.2%; 25-50: 39.4%; 51-65: 33.4% 66-75: 18.7%; > 75: 6.0%	Latino/H 64.6%; AA 16.5%; W 11.33%; Other 6.4%
Becker 2019 [33]	Food pantry clients in TX	891 Adults	Cross-sectional	67.30%	42.07 (14.36)	Latinx/H 76.2%; W 10.1%; AA 5.9%; Other 7.8%
Bergmans 2018 [34]	Women with SNAP	W2: 243 W3: 241 W4: 235 Mothers	Prospective Cohort	100%	<18: 4.7% 18-30: 80.5% 30-40: 14.5% ≥ 40: 0.4%	AA 62.1%; H 21.5%; W 13.3%; Other 3.1%
Bernard 2018 [35]	Parent-child dyads	58 Parent-child dyads	Cross-sectional	Parent 97%; Child 40%	Parent: 37.4 (10.36) Child: 10.56 (2.48)	Parent AA 76%; W 14%; Other 9%; Missing 2%
Black 2012 [36]	Urban, low-income families	26,950 Caregiver-child dyads	Cross-sectional	Caregiver NR; Child 46.8%	Caregiver: 25.6 (5.9); Child: 11.3 mos (9.6)	Children AA 55.2%; H 29.9%; W 13.0%; NA 0.8%; Asian: 1.1%
Braveman 2018 [37]	Postpartum Californian women	27102 Mothers	Cross-sectional	100%	15-19: 6.4%; 20-24: 19.8%; 25-29: 26.6% 30-34: 27.8%; ≥35: 19.4%	Latina 49.8%; W 29.3%; Asian/Pacific Islander (PI) 14.7%; AA 5.7%; American Indian (AI)/ Alaska Native/other 0.5%
Bronte-Tinkew 2007 [38]	Parents of young children	8693 Parents	Prospective Cohort	Parent NR; Child 48.9%	Mother at child's birth: 27.56 (SE 6.4) Child: 10.5 mos (SE 1.9)	NR
Browder 2012 [39]	Mothers in rural America	476 Mothers	Prospective Cohort	100%	30.19	W 67.2%; Latina 25.0%; AA 7.8%
Bulock 2014 [40]	Rural, low-income mothers	215 Mothers	Prospective Cohort	100%	30.66	W 71.8%; H/Latina 15%; AA 7.0%; Native American (NA) 0.9%; Multi-Racial 5.0%; Other: 0.5%

Author and Publication Year	Population	Sample Size	Study Design	Sex, % Female	Age [a]	Race
Burke 2016 [41]	Children and Adolescents	16,918 Children 14,143 Adolescents	Cross-sectional	49.2%	Children (Age 4-11yo): 54.4% Adolescents (Age 12-17yo): 45.6%	Children: W 57.5%; Black, non-Hispanic 13.8%, Other, non-Hispanic 22.6%, Hispanic 6.2% Adolescents: W 59;9%, Black, non-Hispanic 13.8%, Other, non-Hispanic 20.6%, Hispanic 5.7%
Casey 2004 [42]	Mothers in 5 states	5,306 Mothers	Cross-sectional	100%	NR	AA 51.4%; H 34.7%; W 11.9%
Chilton 2014 [43]	Low-income families	44 Mothers	Cross-sectional	100%	Mother: 26.7 (6.6); Child: 17.7 mos (9.6)	Mothers: AA 70.5%; H 22.7%; W 6.82%
Coffino 2020 [44]	NESARC-III	36,145 Adults	Cross-sectional	52%	46.5 (0.199)	W 66.2%; H 14.8%; AA 11.8%; Other 7.3%
Darling 2017 [45]	College freshmen	98 Young Adults	Cross-sectional	75%	18.23 (0.74)	W 66%; AA 20%; More than one race 10%; Other 4%
Dennison 2019 [46]	Children of Seattle, WA	94 Children	Cross-sectional	48.9%	13.57 (3.47)	W 51.1%; AA 17.0%; H 13.8%; Asian 10.6%; Biracial/Other; 7.5%
Distel 2019 [47]	Children of Mexican-origin immigrant families	104 Children	Prospective Cohort	61%	8.39	NR
Doudna 2015 [48]	Rural families	314 Mothers	Cross-sectional	100%	Approx. 30	Non-H W 63.1%
Eiden 2014 [49]	Low-income children	216 Mother-child dyads	Prospective Cohort	Parent 100%; Children 51%	Mother: 29.53 (6.06) Child: at K 5.52 (0.36)	Mothers AA 72%
Ettekal 2019 [50]	Low-income families	169 Mother-child dyads	Prospective Cohort	Parents 100% Children 51%	Mothers:29.78 (5.46)	Mothers AA 74%
Fernández 2018 [51]	Urban 9-year-olds	3,508 Children	Cross-sectional	Parents 100%; Children 52.5%	Mothers: 34.4 (6.0)	Mothers AA 51.9%; W 30.7%; Latina 25.2%; Asian 2.3%; NA 4.2%; Other 10.9%
Frazer 2011 [52]	Rural, low-income families	W1: 413 W2: 314 W3: 265	Prospective Cohort	NR	Parents W1: 30.1; Youngest Child W1: Med 2.0, Range 0-13	W1: W 64.6%; Latino 21.5%; AA 8.8%; NA 0.2%; Asian 0.2%; Multiracial/Other 4.6%
Garg 2015 [53]	Low-income mothers	2,917 Mothers	Prospective Cohort	100%	25.5 (SE 5.8)	W 37.5%; H 34.8%; AA 22.5%; Asian/PI 2.1%; Other 3.1%
Gee 2018 [54]	Kindergarteners in FI homes	1,040 Children	Retrospective Cohort	45.10%	65.73 mos (4.07)	H 38.6%; W 36%; AA 14.5%; Asian 2.1%; Other: NA, PI, or multiracial 8.5%
Gee 2019 [55]	Early Childhood Longitudinal Study (ECLS), K Cohort	7,820 Parent-child dyads	Prospective Cohort	Parents 85% Children 49.1%	NR	Children W 57%; H 22% AA 12%; Asian 4%

Author and Publication Year	Population	Sample Size	Study Design	Sex, % Female	Age [a]	Race
Gill 2018 [56]	Low-income mothers	4,125 Mothers	Cross-sectional	Children 49.0%	Mothers: 30.8 (6.5) Children:2.6 (1.3)	Mothers H/Latina 85.1%; AA 7.2%; W 4.5%; Asian/PI 2.2%
Greder 2017 [57]	Rural, low-income children	370 Mother-child dyads	Cross-sectional	Children 50.3%	Mothers: 32.6 (8.54) Children: 6 (3.25)	Mothers W 66.5%; Latina 24.1%; AA 7.9%; AI or Alaskan Native 2.9%; Asian 1.2%; PI 1.2%; Other 10%; More than once race 10.3%
Grineski 2018 [58]	1st graders in TX	11,958 Children	Cross-sectional	48.40%	Children: 85.45 mos (44.43)	H 25.2% ; AA 13.3%; Asian 4.4%; Other 5.5%
Guerrero 2020 [59]	Infants born in 1998-2000	3,630 Children	Prospective Cohort	Children with FI 9%	NR	Children with FI AA 11%; H 11%; W 8%; Other 7%
Hall 2018 [60]	High school students	7,641 Students	Cross-sectional	53.00%	NR	H 100%
Hanson 2012 [61]	Low-income families	225 Families	Cross-sectional	NR	Parents: 30	Non-W 33.8%
Harrison 2008 [62]	Pregnant women	1,386 Pregnant Women	Cross-sectional	100%	≤17: 17.3% 18-19: 18.2% 20-24: 35.0% 25-29: 16.4% ≥30: 13.1%	AA 44.0%; Asian/PI 19.2%; H (any race) 15.7%; AI 13.9%; W 5.4%; Multiracial 1.7%
Hatem 2020 [63]	Fragile Families and Child Well-Being Study (FFCWS)	2,626 Adolescents	Prospective Cohort	49%	Mothers: 28.16 (6.01)	Adolescents AA 49%; W 27%; H 24%
Heflin 2009 [64]	Parents with newborn children	Y1: 3,541 Y3: 3,516	Prospective Cohort	Parents 100%	Parent Y1: 26.5 Youngest Child Y1: 2.3	Y1: AA 47.9%; H 24.9%; W 23.5%; Other 3.8%
Heflin 2005 [65]	Female welfare recipients	753 Mothers	Prospective Cohort	100%	≥35 W1: 27.0%	W1 AA 50%; W 50%
Heflin 2008 [66]	Panel Study of Income Dynamics	4,438 Families	Prospective Cohort	NR	Parent: 43.21 (SE 10.18) Youngest Child: 4.01 (SE 5.35)	W 61.6%; AA 30.5%; Other 7.9%
Helton 2019 [67]	FFCWS	2,330 Mother-child dyads	Prospective Cohort	Children 48%	Mothers: 25.28 Children: 61.87 mos	AA 49%; H 27%
Hernandez 2014 [68]	FFCWS	1,690 Families	Prospective Cohort	Parents 100%	Mothers: 28.42 (6.05)	AA 44%; H 26%; W 26%; Other 3%
Himmelgreen 1998 [69]	Puerto Rican women	82 Mothers	Cross-sectional	100%	Mothers: 33.3 (5.4)	Puerto Rican 100%
Horodynski 2018 [70]	Growing Healthy Project	567 Families	Cross-sectional	Caregiver NR; Child 51%	Caregiver: 29.5 (6.7) Children: 49.0 mos (6.1)	Caregivers W 62%; AA 30%; H/ Other 8%
Howells 2020 [71]	Pregnant women after Hurricane Florence	83 Mothers	Cross-sectional	100%	Mothers: 30.9	W 88.0%; H 4.8%; AA 3.6%; Other 3.6%
Hromi-Fiedler 2011 [72]	Low-income, pregnant Latinas	135 Women	Cross-sectional	100%	Mothers: 25.24 (5.65)	Puerto Rican 65.2%; Non-Puerto Rican Latina 34.8%

Author and Publication Year	Population	Sample Size	Study Design	Sex, % Female	Age [a]	Race
Huang 2016 [73]	Children in K to fifth grade	7,348 Children	Cross-sectional	Children 49.53%	Mothers: 32.8 (5.8) Children: 68.4 (4.3)	W 60.0%; H 19.3%; AA 13.9%; Other 6.8%
Huddleston-Casas 2009 [74]	Rural, low-income mothers	W1: 413 W2: 325 W3: 270	Prospective Cohort	100%	Mothers: 30.04 (7.72)	W 62.2%; H/Latina 21.4%; AA 11.2%; Other 5.1%
Jacknowitz 2015 [75]	Children	7,850 Children	Prospective Cohort	Children 49.5%	NR	Children W 36.8%; H 24%; AA 19.2%; Other 20.0%
Jackson 2017 [76]	ECLS, K Cohort	6,531 Children	Prospective Cohort	49%	NR	Non-W 37%
Jackson 2017 [77]	ECLS, Birth Cohort	4,721 Adults	Prospective Cohort	NR	NR	NR
Johnson 2018 [78]	Low-income households	2,800 Children	Prospective Cohort	48%	Children: 68.07 mos (4.42)	Mothers W 42%; H 32%; AA 20%; Asian 6%
Johnson 2018 [79]	Children born in 2001	3,600 Children	Prospective Cohort	9 mo cohort 50%; 2 yr cohort 49%; Preschool cohort 48%	68.15 mos (4.39) at 2 yr follow-up: 68.07 mos (4.37) at Preschool follow-up: 68.01 mos (4.36)	at 9 mo. W 39%; H 32%; AA 20%; Other 9%
Koury 2020 [80]	Economically disadvantaged mothers	219 Mother-child dyads	Cross-sectional	100%	NR	NR
Kim 2012 [81]	At-risk mothers	324 Mothers	Cross-sectional	100%	<20: 13% ≥20: 87%	H or Latina 50.0%; AA 25.3%; W 16.4%; Other 8.4%
Kimbro 2015 [82]	Children in FI households	6,300 Children	Retrospective Cohort	50%	Mothers: 33.7 Children: 73.70 mos	W 53%; H 26%; AA 12%; Asian 4%; Other 5%
King 2017 [83]	Urban children	2,829 Children	Cross-sectional	Parent 100%; Child 48%	Children: approx. 5 yrs old	NR
King 2018 [84]	FFCWS	2,488 Children	Prospective Cohort	Parents 100%; Children NR	NR	Mothers AA 52.7%; W 22.4%; H 21.6%
Kleinman 2002 [85]	Inner-city children	97 Children	Prospective Cohort	Children 59%	NR	Children: AA or H >70%
Kleinman 1998 [86]	CCHIP study	328 Children	Cross-sectional	Parents 84%; Children 47%	Child: 8.4	NR
Laraia 2015 [87]	Pregnant women	526 Mothers	Prospective Cohort	100%	Mothers: 30.06 (5.2)	W/Other 87.6%; AA 11.9%
Laraia 2009 [88]	Low-income, first-time AA mothers	206 Mothers	Prospective Cohort	Parents 100%	Mothers: 22.66 (3.77)	AA 100%
Laraia 2006 [89]	Mothers	606 Mothers	Prospective Cohort	100%	Mothers: 27.2 (5.6)	W 58.9%; AA 33.2%; Other 7.9%
Lent 2009 [90]	Poor, rural families	29 Families	Prospective Cohort	Parents 100%	Mothers:29.3	Non-H W 89.7%
Letiecq 2019 [91]	Central American immigrant mothers	134 Mothers	Cross-sectional	Parents 100%	Mothers: 34.63 (7.35)	Latina/H 100%
McLaughlin 2012 [92]	Adolescents, NCS-A 2001 to 2004	6,483 Parent-child dyads	Cross-sectional	NR	Children: Range 13-17	NR

Author and Publication Year	Population	Sample Size	Study Design	Sex, % Female	Age [a]	Race
Mersky 2017 [93]	Low-income women	1,241 Mothers	Prospective Cohort	Parents 100%	Mothers: 24.2 (5.7)	W 33.2%; AA 27.4%; H 22.6%; AI 8.0%; Other 8.9%
Munger 2016 [94]	Mothers with SNAP	1,225 Mothers	Prospective Cohort	Parents 100%	NR	AA 42%; H 30%; W 24%; Other 4%
Murphy 1998 [95]	Low-income children	101 Parent-child dyads	Prospective Cohort	Parents NR, Children 53%	NR	AA 80%
Nagata 2019 [8]	Low-income Latino households	168 Mother-child dyads	Prospective Cohort	Children 49.2%	Mothers at 4-yr follow-up: 30.4 (5.3)	Mexican 59.5%; Other 40.5%
Nelson 2016 [96]	Children	4,900 Children	Prospective Cohort	Children 54%	Mothers: 29.4	W 58.8%; H/Latino 26.1% AA 15.2%; Asian 2.6%; Multiracial/ Other 5.5%
Niemeier 2019 [97]	10-12th grade students	1493 Children	Cross-sectional	Children 53.9%	NR	H 52.8%
Noonan 2016 [98]	ECLS, Birth cohort	Sample A: 8150; Sample B: 9100; Sample C: 7800; Mothers	Prospective cohort	Parents 100%	Mothers at child's birth Sample A: 27.9 (6.31) Sample B: 27.6 (6.34) Sample C: 27.6 (6.29)	Maternal characteristics at birth, Sample A AA 15.6%; H 15.4%; Asian/PI 13.4%; AI 4.4%
Phojanakong 2020 [99]	Families with young children	372 Caregivers	Prospective Cohort	Parents 94.1%	Parents: 28.0 (11.4)	AA 91.1%; H 3.5%; W 2.4%; Other 3.0%
Poll 2020 [100]	Male collegiate athletes	111 Young Adults	Cross-sectional	Adults 0%	21 (2), Range 19-23	W 56.8%; AA 34.2%; Other/ Multiracial: 5.6%; AI or Native Alaskan 1.8%; H 0.9%; Hawaiian/PI: 0.9%
Poole-Di Salvo 2016 [101]	12-16 year-old students	8,600 Adolescents	Cross-sectional	Adolescents 47.8%	Mothers <30: 7.2%; 30-47: 76.9%; >47: 15.9%; Child (range; 12.33-16.90)	W 57.1%; H 18.4%; AA 17.3%; Other 7.2%
Potochnick 2019 [102]	H/Latino Youth	1,362 Youth	Cross-sectional	Children 49.2%	Children:12.2	H 100%
Pulgar 2016 [103]	Latina Women in farmworker families	248 Mother-child dyads	Cross-sectional	Parents 100%	18-25: 29.0% 26-35: 55.7% 36-45: 15.3%	NR
Raiford 2014 [104]	Young, AA women in resource-poor communities	237 Mothers	Cross-sectional	Parents 100%	Mothers 17.6 (1.0)	AA 100%
Richards 2020 [105]	Pregnant women	752 Mothers	Prospective Cohort	Parents 100%	Mothers:28.9 (5.6)	W 64.6%; H 20.4%; AA 5.5%; Other 9.5%
Rodriguez-JenKins 2014 [106]	Families with child welfare	771 Caregivers	Cross-sectional	Caregivers 92%	Caregivers 32.4	W 62%; AA 5%; AI/Alaskan Native 6.6%; Latino 5.4%; Asian American/PI 1.9%; Multiracial 17.1%
Rongstad 2018 [107]	Children	1,330 Children	Cross-sectional	Children 50.3%	0-1: 5%; 2-5: 36%; 6-10: 32%;	W 77.4%; H/ Latino 8.4%; AA 4.7%; Asian 4.3%;

Author and Publication Year	Population	Sample Size	Study Design	Sex, % Female	Age [a]	Race
					11-15: 20%; 16-20: 7%	Multiracial/Other 5.2%
Rose-Jacobs 2008 [108]	Low-income families	2,010 Caregiver-child dyads	Cross-sectional	Children 53.6%	Caregiver <21: 14.2%; Children 4-12m: 40%; 13-24m: 39%; 25-36m: 21%	Caregiver AA 59.3%; H 19.8%; W 19.7%; Asian 1%; NA 1%
Rose-Jacobs 2019 [109]	Pregnant women on opioid agonist treatment	75 Women	Cross-sectional	Parents 100%; Children 52.3%	Mothers: 28.8 (5.2)	Mothers W, non-H 82.9%
Rose-Jacobs 2019 [110]	Pregnant women being treated for opioid use	100 Women	Cross-sectional	Parents 100%	Mothers: 28.6 (5.1)	W/non-H 73.0%
Rosenthal 2015 [111]	Disadvantaged pregnant young women	484 Mothers	Prospective Cohort	Parents 100%	Mothers: 18.66 (1.68)	Latina 54.5%; AA 33.5%
Salas-Wright 2020 [112]	Venezuelan immigrant children	399 Children	Cross-sectional	Children 43.61%	Children:14.4 (1.75)	NR
Sun 2016 [113]	Mothers	1,255 Mothers	Cross-sectional	Parents 100%	Caregiver: Median 24, Range 22-28 Child: Median 18.5mos, Range 9-31	H 47.5%; AA 39.0%; W 10.6%; Other 3%
Sidebottom 2014 [114]	Women at urban community health center	594 Mothers	Prospective Cohort	Parents 100%	Mothers: 21.9 (5.45); <20: 39.5%; 20-24: 36.6%; ≥25: 23.8%	AA 50.5%; NA 20.2%; Asian/PI 16.0%; H 7.7% W 3.9%; Multiple 1.7%
Siefert 2007 [115]	Low-income, AA mothers	824 Mothers	Cross-sectional	Parents 100%	Mothers 18-24: 36.7%; 25-34: 50%; 35-54: 13.2%	AA 100%
Siefert 2001 [116]	Single women receiving welfare	724 Mothers	Cross-sectional	Parents 100%	Mothers 25-34: 46.3%; ≥35: 25.7%	AA 55.8%; Non-H W 44.2%
Slack 2005 [117]	Families receiving welfare	W1: 1,363 W2: 1,183 Children	Prospective Cohort	Children 47.8%	Children 3-5: 37.8%, 6-12: 62.2%	Caregiver: AA 78.7%; Children: AA 80%
Slopen 2010 [118]	Children	2,810 Children	Prospective Cohort	Children 50.50%	Caregiver: 35.58 (0.31) Children: 8.16 (0.05)	Children H 42.54%; AA 31.92% W 13.82%; Other 11.72%
Ten Haagen 2014 [119]	Families in Boston	308 Families	Prospective Cohort	Caregivers 100%	Mothers: 33.88 (7.46)	AA 47%; H 33%; W 7%; Other 13%
Testa 2020 [120]	Adolescents	12,228 Adolescents	Prospective Cohort	54.40%	NR	W 56.6%; AA 19.7%; H 15.6%; Other 8.1%
Thomas 2019 [121]	Children ages 2 to 17 yrs	29,341 Children	Cross-sectional	Children 48.5%	Children: 9.65 (4.69)	Children W 50.5%; H 27.3%; AA 14.0%; Asian 5.8%; Other 2.5%
Trapp 2015 [122]	Low-income, preschool children	222 Children	Cross-sectional	Children 50%	Children: 35mos (8.7)	Puerto Rican 61%; H, non-Puerto Rican 29%; AA 10%

Author and Publication Year	Population	Sample Size	Study Design	Sex, % Female	Age [a]	Race
Tseng 2017 [123]	Matched child-parent data from the 2014 to 2015 NHIS	18,456 Parent-child dyads	Cross-sectional	Parents 61%	Parents 18-29: 22%; 30-39: 34%; ≥40: 44%	Parents W 56.7%; H 21.5%; AA 11.6%; Other 10.3%
Vaughn 2016 [124]	NESARC	34,427 Adults	Prospective Cohort	51.94%	49.1 (17.3)	W 70.67%; AA 11.29%; H 4.31%; Other 11.37%
Wu 2018 [125]	ECLS, Birth Cohort	6,970 Children	Prospective Cohort	Parents 100%; Children 49.2%	NR	Children W 40.8%; H 20.0%; AA 15.6%; Asian/PI 11.6% NA/Alaskan Native 3.4%; Multiracial 8.4%
Ward 2019 [126]	Families in AR	693 Caregivers	Cross-sectional	Caregivers 100%; Children 50.8%	NR	AA 55.7%; W 22.2% H 14.3%; Other 7.8%
Weinreb 2002 [127]	Homeless and low-income mothers and children	322 Mothers 355 Children	Case-control	Caregivers 100%; Children 45.4%	Mothers: 30.4 Children: School-aged: 10.1; 57.2% Preschool-aged: 4.2; 42.8%	Mothers: Puerto Rican 41.8%; W 33.5%, AA 13.4%, Other 11.2%
West 2019 [128]	Adolescents in Project EAT	2,179 Adolescents	Prospective Cohort	52.80%	14.9 (1.6)	W 63.42%; Asian 19.18%; AA 10.00%; H 3.95%; Other 2.75%
Whitaker 2006 [129]	Mothers and preschool aged children	2,870 Mother-child dyads	Cross-sectional	Parents 100%	NR	Mothers AA 50.7%; H 23.4%; W 22.6%; Other 3.3%
Whitsett 2019 [130]	Welfare, Children, and Families Study	1,049 Children	Prospective Cohort	Children 54%	Caregiver: 38.03 (7.71) Children: 12.02 (1.39)	Caregiver AA 41%; H 53%; W 5%
Willis 2016 [131]	Middle school students	324 Children	Cross-sectional	Children 53.60%	Children: 11.4 (0.92)	Children: W 52.10%; H 20.70%
ZasLow 2009 [132]	ECLS, Children Cohort	8,944 Children	Prospective Cohort	Parents 100%; Children 48.9%	Mothers at child's birth: 27.3 (13.1) Children: 24.4mos (2.5)	Children W 43.1%; Other 20.9%; H 20.2%; AA 15.9%;
Zekeri 2019 [133]	AA single mothers living with HIV/AIDS	190 Mothers	Cross-sectional	Parents 100%	NR	AA 100%

Table 2: Study characteristics for the 108 studies included in qualitative analysis, including information regarding FI.

[a] Mean (SD) in years, unless otherwise indicated.

[b] Mean (SD) unless otherwise indicated. Abbreviations: AA, African American; H, Hispanic; W, White; NHANES, National Health and Nutrition Examination Survey; FI, Food Insecurity; NR, not reported; RCFIM, Radimer Cornell Food Insecurity Measure; SNAP, Supplemental Nutrition Assistance Program; W1, Wave 1; W2, Wave 2; W3, Wave 3; W4, Wave 4; HVS, Hunger Vital Sign; USDA, United States Department of Agriculture; HFSSM, Household Food Security Survey Module; PI, Pacific Islander; AI, American Indian; FS, Food Security; LFS, Low Food Security; VLFS, Very Low Food Security; NA, Native American; NESARC-III, National Epidemiological Survey on Alcohol and Related Conditions III; CCHIP, Community Childhood Hunger Identification Project; FFCWS, Fragile Families and Child Welfare Study; K, Kindergarten; MFS, Marginal Food Security; NCS-A, National Comorbidity Survey Replication Adolescent Supplement; ECLS, Early Childhood Longitudinal Study; NCAA, National Collegiate Athletic Association; EAT, Eating Among Teens and Young Adults; HIV/AIDS, Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

Table 3.

Risk of Bias and Confounding for the studies included in qualitative analysis

Study ID	Risk of Bias	Risk of Confounding
Adynski 2019 [27]	Medium	Low
Ajrouch 2010 [28]	Low	Low
Alaimo 2002 [29]	Low	Low
Ashiabi 2007 [30]	Low	Low
Austin 2017 [31]	Low	Medium
Becker 2017 [32]	Medium	High
Becker 2019 [33]	Medium	High
Bergmans 2018 [34]	Low	High
Bernard 2018 [35]	Low	High
Black 2012 [36]	Low	High
Braveman 2018 [37]	Medium	High
Bronte-Tinkew 2007 [38]	Medium	Low
Browder 2012 [39]	Medium	Medium
Bulock 2014 [40]	Low	High
Burke 2016 [41]	Low	Low
Casey 2004 [42]	Low	Low
Chilton 2014 [43]	High	High
Coffino 2020 [44]	Medium	Low
Darling 2017 [45]	Low	High
Dennison 2019 [46]	Low	Medium
Distel 2019 [47]	Medium	High
Doudna 2015 [48]	Low	Low
Eiden 2014 [49]	Low	Low
Ettekal 2019 [50]	Low	Low
Fernández 2018 [51]	Low	Low
Frazer 2011 [52]	Low	Low
Garg 2015 [53]	Low	Low
Gee 2018 [54]	Low	High
Gee 2019 [55]	Low	Low
Gill 2018 [56]	Low	High
Greder 2017 [57]	Low	Low
Grineski 2018 [58]	Low	Medium
Guerrero 2020 [59]	Medium	Low
Hall 2018 [60]	Low	Medium
Hanson 2012 [61]	Medium	Medium

Study ID	Risk of Bias	Risk of Confounding
Harrison 2008 [62]	Low	High
Hatem 2020 [63]	Low	Low
Heflin 2005 [65]	Low	Low
Heflin 2008 [66]	Low	Low
Heflin 2009 [64]	Low	Low
Helton 2019 [67]	Low	Low
Hernandez 2014 [68]	Medium	Low
Himmelgreen 1998 [69]	High	High
Horodynski 2018 [70]	Low	High
Howells 2020 [71]	Medium	Low
Hromi-Fiedler 2011 [72]	Low	Low
Huang 2016 [73]	Low	Low
Huddleston-Casas 2009 [74]	Low	Medium
Jacknowitz 2015 [75]	Medium	Medium
Jackson 2017 [76]	Medium	Medium
Jackson 2017 [77]	Medium	Low
Johnson 2018 [78]	Low	Medium
Johnson 2018 [79]	Medium	Low
Kim 2012 [81]	Medium	Medium
Kimbro 2015 [82]	Low	Low
King 2017 [83]	Medium	Low
King 2018 [84]	Medium	Low
Kleinman 1998 [86]	Low	High
Kleinman 2002 [85]	Low	High
Koury 2020 [80]	Low	Low
Laraia 2006 [89]	Low	Low
Laraia 2009 [88]	Low	Low
Laraia 2015 [87]	Low	Low
Lent 2009 [90]	Medium	High
Letiecq 2019 [91]	Low	Low
McLaughlin 2012 [92]	Low	Low
Mersky 2017 [93]	Low	Medium
Munger 2016 [94]	Low	Low
Murphy 1998 [95]	Medium	Low
Nagata 2019 [8]	Medium	Low
Nelson 2016 [96]	Low	Low
Niemeier 2019 [97]	Low	Medium

Study ID	Risk of Bias	Risk of Confounding
Noonan 2016 [98]	Medium	Low
Phojanakong 2020 [99]	Low	Low
Poll 2020 [100]	Medium	High
Poole-Di Salvo 2016 [101]	Low	Low
Potochnick 2019 [102]	Low	Low
Pulgar 2016 [103]	Low	Low
Raiford 2014 [104]	Low	High
Richards 2020 [105]	Medium	Low
Rodriguez-JenKins 2014 [106]	Medium	Medium
Rongstad 2018 [107]	Medium	Medium
Rose-Jacobs 2008 [108]	Low	High
Rose-Jacobs 2019 [109]	Medium	Medium
Rose-Jacobs 2019 [110]	Low	High
Rosenthal 2015 [111]	Medium	Medium
Salas-Wright 2020 [112]	Low	Medium
Sidebottom 2014 [114]	Low	Medium
Siefert 2001 [116]	Low	Low
Siefert 2007 [115]	Low	Medium
Slack 2005 [117]	Low	Low
Slopen 2010 [118]	Medium	Medium
Sun 2016 [113]	Medium	Low
Ten Haagen 2014 [119]	High	Medium
Testa 2020 [120]	Medium	Medium
Thomas 2019 [121]	Low	Low
Trapp 2015 [122]	Low	High
Tseng 2017 [123]	Low	Low
Vaughn 2016 [124]	Low	Medium
Ward 2019 [126]	Medium	Low
Weinreb 2002 [127]	Medium	Low
West 2019 [128]	Low	Medium
Whitaker 2006 [129]	Low	Low
Whitsett 2019 [130]	Low	Low
Willis 2016 [131]	Medium	High
Wu 2018 [125]	Low	High
Zaslow 2009 [132]	Medium	Low
Zekeri 2019 [133]	Low	Medium

[a]Risk of Bias based on Agency for Healthcare Research and Quality RTI Item Bank, items 1, 3, 7, 8, 9, and 11. Bias by total score: Score 0 = “Low-risk”; 1 = “Medium-risk”; 2+ or a Fatal Flaw is present = “High-risk”. Risk of Confounding based on Agency for Healthcare Research and Quality RTI Item Bank, items 6, 12, and 13. Confounding by total score: Score 0 = “Low-risk”; 1 = “Medium-risk”; 2+ = “High-risk”.[24]