Hunger: Its Impact on Children's Health and Mental Health

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ABSTRACT. *Objective.* **Hunger, with its adverse consequences for children, continues to be an important national problem. Previous studies that document the deleterious effects of hunger among children cannot distinguish child from family hunger and do not take into account some critical environmental, maternal, and child variables that may influence child outcomes. This study examines the independent contribution of child hunger on children's physical and mental health and academic functioning, when controlling for a range of environmental, maternal, and child factors that have also been associated with poor outcomes among children.**

Methods. **With the use of standardized tools, comprehensive demographic, psychosocial, and health data were collected in Worcester, Massachusetts, from homeless and low-income housed mothers and their children (180 preschool-aged children and 228 school-aged children). Mothers and children were part of a larger unmatched case-control study of homelessness among female-headed households. Hunger was measured by a set of 7 dichotomous items, each asking the mother whether she has or her children have experienced a particular aspect of hunger during the past year—1 concerns food insecurity for the entire family, 2 concern adult hunger, and 4 involve child hunger. The items, taken from the Childhood Hunger Identification Project measure, are summed to classify the family and divided into 3 categories: no hunger, adult or moderate child hunger, or severe child hunger (indicating multiple signs of child hunger). Outcome measures included children's chronic health condition count using questions adapted from the National Health Interview Survey, Child Health Supplement, and internalizing behavior problems and anxiety/depression, measured by the Child Behavior Checklist. Additional covariates included demographic variables (ie, age, gender, ethnicity, housing status, number of moves, family size, income), low birth weight, child life events (ie, care and protection order, out of home placement, abuse, severe life events count), developmental problems (ie, developmental delay, learning disability, emotional problems), and mother's distress and psychiatric illness. Multivariate regression analyses examined the effect of child hunger on physical and mental health outcomes.**

Results. **The average family size for both preschoolers and school-aged children was 3; about one third of both groups were white and 40% Puerto Rican. The average income of families was approximately $11 000. Among the school-aged children, on average 10 years old, 50% experienced moderate child hunger and 16% severe child hunger. Compared with those with no hunger, school-aged children with severe hunger were more likely to be homeless (56% vs 29%), have low birth weights (23% vs 6%), and have more stressful life events (9 vs 6) when compared with those with no hunger. School-aged children with severe hunger scores had parent-reported anxiety scores that were more than double the scores for children with no hunger and significantly higher chronic illness counts (3.4 vs 1.8) and internalizing behavior problems when compared with children with no hunger. There was no relationship between hunger and academic achievement.**

Among preschool-aged children, who averaged 4 years of age, 51% experienced moderate child hunger and 8% severe child hunger. For preschoolers, compared with children with no hunger, severe hunger was associated with homelessness (75% vs 48%), more traumatic life events (8.5 vs 6), low birth weight (23% vs 6%), and higher levels of chronic illness and internalizing behavior problems. Mothers of both preschoolers and school-aged children who reported severe hunger were more likely to have a lifetime diagnosis of posttraumatic stress disorder.

For school-aged children, severe hunger was a significant predictor of chronic illness after controlling for housing status, mother's distress, low birth weight, and child live events. For preschoolers, moderate hunger was a significant predictor of health conditions while controlling for potential explanatory factors. For both preschoolers and school-aged children, severe child hunger was associated with higher levels of internalizing behavior problems. After controlling for housing status, mother's distress, and stressful life events, severe child hunger was also associated with higher reported anxiety/depression among school-aged children.

Conclusion. **This study goes beyond previous research and highlights the independent relationship between severe child hunger and adverse physical health and mental health outcomes among low-income children. Study findings underscore the importance of clinical recognition of child hunger and its outcomes, allowing for preventive interventions and efforts to increase access to food-related resources for families.** ***Pediatrics*** **2002;110(4). URL: http://www.pediatrics.org/cgi/content/full/110/4/e41;** ***child hunger, physical health, mental health.***

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ABBREVIATIONS. CBCL, Child Behavior Check List; WIAT, Wechsler Individual Achievement Test Screener.

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Hunger, with its associated adverse consequences for children, continues to be an important national problem. Estimates report that >14 million children live in food-insecure families—ones in which there is limited or nutritionally inadequate food as a result of lack of money or resources to gain access to it.[1] Research that examines the extent to which family hunger in the United States independently predicts adverse health and mental health outcomes among children is limited.[2–6]

Several reports during the past few years have documented the deleterious effects of periodic hunger among children in the United States on behavioral, emotional, academic, and health outcomes.[2–6] However, most of these studies have not controlled for many potentially confounding sociodemographic, environmental, or maternal factors that could also explain adverse child outcomes.[2–4] The work of Alaimo et al,[5,6] which does account for a selection of demographic, family, and environmental factors relevant to children's outcomes, found a significant relationship between hunger and poorer health status and academic performance among children. Those studies, however, used a 1-item family hunger measure that cannot distinguish child from family hunger and does not take into account some critical maternal and child variables that may influence outcomes. In this study, family hunger is defined as resource-constrained food insufficiency among adults with children experiencing moderate food problems, whereas severe child hunger includes multiple signs of food insufficiency for children, such as reduced or skipped meals.

As part of a comprehensive epidemiologic study of homeless and low-income housed families and children in Worcester, Massachusetts, the present study design moves beyond previous research of hunger's impact on children's health and well-being. The aim of this analysis was to determine the independent effect of hunger on children's physical and mental health and academic performance, when controlling for a range of potential explanatory factors that have also been associated with poor outcomes among children.

METHODS

Sample

This analysis focuses on 180 preschool-aged children (2.5–6 years) and 228 school-aged children (6–17 years) who participated in an unmatched case-control study of family homelessness in Worcester, Massachusetts. These children are part of a larger study that consists of 220 homeless and 216 low-income, never-homeless mothers and 627 dependent children.

A detailed description of the study design, enrollment, and data collection have been provided elsewhere.[7–9] All families who stayed in 1 of Worcester's 9 family shelters or 2 welfare hotels for 7 or more days between 1992 and 1995 were enrolled into the study. The goal was to reach the entire population of homeless families. As in many mid- and large-sized American cities, the vast majority of homeless families in Massachusetts are headed by women. Thus, we enrolled only female-headed families that were currently living in a shelter along with their dependent children. During the same time frame, a comparison group of never-homeless female-headed families that were receiving Aid to Families with Dependent Children and residing in public or private housing were enrolled from the Department of Public Welfare Office. For the most part, these mothers were coming for a random redetermination of benefits, resulting in a random sample of Aid to Families with Dependent Children recipients. Mothers were asked permission to enroll 1 infant, 1 preschool-aged child, and up to 2 school-aged children per family.

Because the primary explanatory variable is hunger, 53 children without hunger scale scores were dropped from this analysis (28 preschool- and 25 school-aged children). Some children are missing hunger data because the instrument was added after the interviews had started. Because interviews were conducted on the basis of family availability rather than housing status (the main outcome for the initial study design), this lag should not have introduced any systematic bias for the current analysis.

Assessment

Mothers from both groups completed a comprehensive, 10- to 12-hour interview that included a range of factors hypothesized to be associated with homelessness, such as housing histories, health, and life events. Mothers also provided information about family and child hunger and each child's health, behavior, educational experiences, and life events. School-aged children completed direct assessments of school achievement, stressful life events, and quality of life.

All instruments in this study were selected on the basis of reliability, validity, and previous use with homeless or extremely low-income groups. Both mother and child protocols were translated into Spanish by Puerto Rican bilingual and bicultural translators. Human subject review of the interview protocol and study design was completed annually through the University of Massachusetts Medical School Institutional Review Board. The primary outcomes of interest were health, internalizing problems, and anxiety/depression.

Internalizing problems and anxiety were assessed with the age-appropriate version of the Child Behavior Check List (CBCL).[10] This widely used instrument contains 118 behavior questions that primary caregivers rate on a 3-point scale. There is a total problem, internalizing, and externalizing global scale that can be compared across age groups (2.5–4 years and 4–18 years). Raw scores are converted to standardized scores using normative data. These standardized scores have a mean of 50 and a standard deviation of 10. In addition to the summary scales, the school-age instrument includes an anxious/depressed subscale. The raw scores on this scale range between 0 and 35 with higher scores representing greater distress. Both the preschool- (2.5–4 years) and school-age (4–18 years) versions of the instrument have been shown to be reliable and valid.[10]

Each child's health status was assessed using questions adapted from the National Health Interview Survey, Child Health Supplement.[11] Mothers reported information on 35 chronic health conditions in their children's lifetime. Positive answers were summed to create a lifetime health conditions count with scores that ranged from 0 to 35. Similarly, positive answers from 16 questions on current health symptoms were summed to create a current symptom count variables (range: 0–16). There was also a single item for which mothers rated their children's overall health status. Rating options included "excellent," "very good," "good," "fair," and "poor."

School-aged children completed a direct assessment of academic achievement called the Wechsler Individual Achievement Test (WIAT) Screener.[12] The WIAT Screener includes a module on basic reading (English only), spelling (English only), and math. Each module produces a raw score that is then converted into a standardized score using age-appropriate normative data. These standardized scores have a mean of 100 and a standard deviation of 15. There is also a composite score that is the aggregate of all 3 subscales. The WIAT has been shown to have strong reliability and good criterion-related validity.[12] For all school-aged children, mothers reported on school-related difficulties, such as suspension, repeated grades, and number of missed days.

Hunger—food insufficiency as a result of constrained resources—is measured by a set of 7 dichotomous items, each asking the mother whether she or her children have experienced a particular aspect of hunger during the past year. One item concerns food insecurity for the entire family, 2 concern adult hunger, and 4 concern child hunger. The items, taken from the Community Childhood Hunger Identification Project measure,[2,13,14] are summed to classify the family. The instrument shows strong in-

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ternal consistency in our sample (Kuder-Richardson 20 is 0.84, and average correlation among items is 0.45 with a range of 0.22–0.76.)

Children older than 9 years were asked directly how often they got very hungry because they did not have enough food to eat (response choices ranged from 0 = never to 5 = every day). An item-by-item analysis showed that there was a significant concordance between mother-reported responses to the question, "Did your children ever say they were hungry because there was not enough food in the house?" and a child's report of hunger ($r = 0.19$, $P = .03$). This correlation corroborates earlier research[3] and suggests that mothers are reliable reporters of child hunger. It also suggests that at this age, children can differentiate between a short-term appetite report and a long-term food insufficiency problem.

The 7-item hunger scale is divided into 3 categories: no hunger (score of 0); adult and moderate child hunger (score of 1–5), and severe child hunger (score of 6 or 7), the last indicating multiple signs of child hunger. By definition, families with scores of 6 or 7 answered positively to either 3 or 4 of the child hunger items as well as the food insecurity and adult hunger items. Because the goal of this analysis was to understand the independent effect of hunger on negative outcomes in poor children, we set cutpoints to distinguish between severe child hunger (multiple signs of it) and moderate child hunger (a single indicator of it). In addition, all mothers in families that had a hunger score of 6 had told us that their children had reported hunger when there was no food (in the home) to give them. Because this item is significantly correlated with older children's reports of often being very hungry because there was not enough food to eat, a cutpoint of 6+ to designate severe child hunger seemed prudent.

Additional covariates include variables related to demographics (age, gender, ethnicity, housing status, moves in the past year, family size, family income), low birth weight, child life events (care and protection order, abuse, out-of-home placement, strains and worries, and severe life events count[15]), developmental problems (developmental delay, learning disability, emotional problems), and mother's distress[16] and lifetime psychiatric illness.[17]

Data Analysis

The first step in data analysis was to compare those with and without family hunger scores. Among preschool-aged children, those without moderate hunger were more likely to be white or black and less likely to be Puerto Rican than were preschool-aged children with moderate hunger ($P = .005$). However, both groups were similar in terms of age, family size, income, gender, and housing status. In the school-aged group, those with and without scores were similar in terms of family size, income, housing status, gender, and race/ethnicity. School-aged children who had not experienced hunger scores were significantly younger than those who had ($P = .05$).

Initial descriptive analyses comparing the responses of school-aged and preschool-aged children in the 3 hunger groups used standard χ^2 tests for discrete variables and 1-way analysis of variance for continuous variables. However, for the multivariable regression modeling, we took into account that the analyses used the responses of 202 school-aged children from 155 families. Data collected from children in the same family are not independent. To account for the correlation in school-aged respondents, we used the method of generalized estimating equations,[18] as implemented in SAS's Proc Genmod.[19]

Multivariable regression models were developed using the following modeling procedure described by Hosmer and Lemeshow[20] for logistic regression and adapted to the current setting. For a particular outcome, variables initially entered into the multivariable model were all those significant at the 25% level in the univariable regression model (results not shown). In addition, we entered housing status to control for the case-control design and mother's distress to adjust for reporting bias. This multivariable model was simplified by successively removing the least significant variable and verifying that it was not a confounder of the effects of the variables that remained in the model. This process continued until the model contained only significant ($P < .05$) or important confounders. At this point, we added into the model, 1 at a time, all variables not initially selected for the first multivariable model. No additional variables were selected. The last step was to check for interactions among the variables in the multivariable model. There was only 1 significant interactions between gender and homelessness in the preschool internalizing model. As a final step, hunger was added to each model to determine whether it explains additional variance.

Regression models for school-aged and preschool-aged experiences are modeled separately. Each multivariate model is developed using covariates that have been identified in previous research.[8,9,21] Covariates for the school-aged multivariate CBCL models include the following: demographics (age, nonwhite race, gender), low birth weight, stressful life events (abuse history and life events count), and residential instability.

For the preschool-aged children, we started with previously validated models for the CBCL internalizing score and the health conditions count[8,9] (data for 28 children were dropped because they had no hunger scores). For the CBCL internalizing score, these variables include child's age, race/ethnicity, gender, mother's distress (Symptom Checklist-Global Severity Index), foster care placement, death of a childhood friend, housing status, and a housing status/gender interaction.[8] Death of a childhood friend was dropped because of missing data (5 of 6 children with a death had no family hunger score). With the exception of this 1 change, we re-created the original model and added hunger. For the health condition models, nominated predictors for both school-aged and preschool-aged children include age, race/ethnicity, family size, mother's distress, low birth weight, abuse, life events, and health status.

RESULTS

The 155 mothers with school-aged children were on average 33 years old and had lived in Worcester for 12.3 years. Approximately 43% of the mothers had graduated from high school or passed the Generalized Educational Development test, and 44.9% had never been married. The 167 mothers with preschool-aged children were on average 27 years old and had lived in Worcester for 11 years. Fewer than half (44%) of these mothers had graduated from high school (data not shown).

As indicated in Table 1, the school-aged children were on average 10 years old. Approximately half of the school-aged children were boys and lived in families with a total of 3 children. The average family income for children in this sample was $11 338. Approximately one fifth of the children had experienced some type of out-of-home placement. Close to one third had care-and-protection orders at some point in their lives, and 18% had experienced physical or sexual abuse. Approximately one quarter of the children had an emotional problem, one fifth had a learning disability, and one tenth had a developmental delay. More than one third of the group had repeated a grade, and approximately 20% had been suspended.

Preschool-aged children were on average 4 years old (Table 2). Approximately 35% of these children are white, and 40% are Puerto Rican. The remaining 25% are black or of another race/ethnicity. Almost two thirds of the preschool-aged children are boys. As with school-aged children, the average family size was almost 3 and the average income was $10 587. Approximately half of the preschool-aged children had been homeless and had moved an average of 2 times in the past year.

In terms of hunger status, 34% of school-aged children had no hunger reported by their mothers (Table 1). By comparison, mothers reported moderate hunger for approximately half of the children and severe hunger for 16% of the children. School-aged children with more hunger signs were more likely to be white

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TABLE 1. School-Aged Child and Maternal Characteristics by Child Hunger Status

Characteristic	All (n = 203)	No Hunger (n = 68)	Moderate Child Hunger 1–5 (n = 103)	Severe Child Hunger 6+ (n = 32)	P Value
Child age	10.1	6.01	10.5	10.3	.14*
Percentage 9 years old+	60.6%	50.0%	67.0%	62.5%	.08†
Race/ethnicity					.01†
White	32.0%	22.1%	39.8%	28.1%	
Black	15.8%	43.1%	21.4%	6.2%	
Puerto Rican	43.8%	34.2%	33.0%	56.2%	
Other	8.4%	28.1%	5.8%	9.4%	
Male	50.2%	52.9%	49.5%	46.9%	.83†
Family size	3.3	3.4	3.2	3.7	.09*
Mother high school graduate	42%	42.6%	46.6%	25.0%	.09†
Mean family income	$11 338	$10 560	$11 685	$11 859	.60*
Homeless	35.0%	29.4%	32.0%	56.2%	.02†
Moves in past year	1.77	1.37	1.77	2.71	.005*
Low birth weight	12.2%	6.1%	13.0%	23.3%	.05†
Pregnancy substance abuse	6.4%	4.4%	8.7%	3.1%	.38†
Health conditions (0–35)‡	2.2	1.8	2.2	3.4	.002*
Symptoms count (0–16)§	0.63	0.6	0.5	0.9	.13*
Excellent/Good Health	68.5%	69.1%	69.9%	62.5%	.73†
Out-of-home placement	20.2%	14.7%	20.4%	31.2%	.16†
Physical or sexual abuse	17.7%	14.7%	19.4%	18.8%	.72†
Care and protection order	33.0%	26.5%	36.9%	34.4%	.36†
Mean child life events	7.2	6.01	7.5	8.8	.009*
Quality of Life‖	8.3	8.0	8.4	8.4	.52*
Parent report CBCL scores					
Total problems	29.3	24.9	29.0	40.1	.04*
Internalizing problems	52.1	49.7	51.8	58.4	.006*
Externalizing problems	52.2	51.0	51.9	55.7	.22*
Anxiety	3.9	2.8	3.9	6.3	.002*
WIAT‖					
Composite	92.1	91.0	91.8	93.6	.79*
Math	91.7	91.2	91.2	94.8	.48*
Reading	94.0	92.4	93.6	96.1	.62*
Spelling	93.0	91.4	92.9	93.1	.80*
Developmental delay	11.8%	4.4%	15.5%	15.6%	.07†
Emotional problem	24.1%	19.1%	25.2%	31.2%	.39†
Learning disability	22.7%	16.2%	26.2%	25.0%	.29†
Repeat grade	34.5%	30.9%	32.0%	50.0%	.13†
Suspended	19.7%	17.7%	18.4%	28.1%	.42†
Attend special classes	22.3%	29.4%	21.6%	9.4%	.08†
Mean school days missed in the past year	9.4	8.3	8.4	13.3	.09*
Mother's distress (GSI)	0.78	0.71	0.76	0.98	.14*
Lifetime PTSD	37.3%	26.5%	38.6%	56.2%	.02†
Lifetime major depression	44.6%	41.8%	43.7%	53.1%	.55†
Lifetime substance abuse	40.4%	25.0%	52.4%	34.4%	.001†

GSI indicates Global Severity Index; PTSD, posttraumatic stress disorder.
* P value based on 1-way analysis of variance.
† P value based on a χ^2 test.
‡ Lifetime health conditions.
§ Symptoms in the past month.
¶ Child-reported item/direct assessment.

or Puerto Rican. More than half of the school-aged children with severe hunger were homeless compared with 30% with no hunger. Similarly, school-aged children with severe hunger were more likely to have had low birth weight (23% for severe hunger vs 6.1% for no hunger), more chronic health conditions (3.4 vs 1.8), and more stressful life events (8.8 vs 6.0). On all of these measures, school-aged children with moderate hunger fell between the severely hungry and nonhungry groups.

School-aged children with severe hunger scores had parent-reported anxiety scores that were more than double the scores for children with no hunger (6.3 vs 2.8). School-aged children with moderate hunger had modest mother-reported anxiety scores (3.9). This pattern was repeated for the CBCL total problem score, internalizing problem score, the anxiety problem subscale and the attention problem subscale. School-aged children with severe hunger had significantly higher chronic illness condition counts than children with modest or no hunger. There was no relationship between hunger and academic achievement, school-related issues, or attendance.

For preschool-aged children, hunger was associated with low birth weight and life events (Table 2). One quarter of preschool-aged children with severe hunger were born under weight, compared with 5% of children with no hunger. Similarly, preschool-aged children with severe hunger had an average of 8.5 traumatic life events in the past year compared with 6.0 for children with no family hunger. In both cases, preschool-aged children with moderate hun-

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TABLE 2. Preschool-Aged Child and Maternal Characteristics by Child Hunger Status

Characteristic	All (n = 152)	No Hunger (n = 62)	Moderate Child Hunger 1–5 (n = 78)	Severe Child Hunger 6+ (n = 12)	P Value
Child age	4.2	4.1	4.1	4.8	.17*
Race/ethnicity					.12†
White	34.9%	32.3%	39.7%	16.7%	
Black	11.2%	9.7%	12.8%	8.3%	
Puerto Rican	40.1%	45.2%	30.8%	75.0%	
Other	13.8%	12.9%	16.7%	0	
Male	60.5%	59.7%	62.8%	50.0%	.69†
Family size	2.7	2.7	2.6	3.2	.27*
Mother high school graduate	45.4%	43.6%	48.7%	33.3%	.57†
Mean family income	$10 587	$10 957	$10 217	$11 166	.37*
Homeless	48.0%	48.4%	43.6%	75.0%	.13†
Moves in past year	2.3	1.8	2.8	2.2	.21*
Low birth weight	6.1%	5.1%	3.9%	25.0%	.02†
Health conditions (0–35)‡	2.4	1.9	2.6	2.8	.004*
Symptoms count (0–16)§	1.6	1.3	1.6	2.5	.26*
Excellent/good health	66.4%	72.6%	64.1%	50.0%	.26†
Out-of-home placement	11.8%	9.7%	14.1%	8.3%	.67†
Physical or sexual abuse	9.2%	8.1%	10.3%	8.3%	.90†
Care and protection order	31.6%	22.6%	38.5%	33.3%	.13†
Mean child life events	7.2	6.0	8.0	8.5	.02*
Parent report CBCL scores					
Total problems	33.1	28.2	36.8	34.4	.04*
Internalizing problems	51.1	48.4	52.9	53.2	.06*
Externalizing problems	52.4	50.7	53.8	52.4	.28*
Developmental delay	21.7%	21.0%	20.5%	33.3%	.59†
Emotional problem	18.4%	11.3%	21.8%	33.3%	.11†
Learning disability	9.0%	9.4%	9.5%	0	.73†
Ever in early intervention	16.5%	13.5%	21.3%	0	.30†
Ever in healthy start	42.3%	51.9%	35.8%	36.4%	.19†
Ever in preschool	27.4%	20.9%	31.8%	27.3%	.47†
Mother's distress (GSI)	0.74	0.65	0.80	0.79	.15*
Lifetime PTSD	42.7%	29.5%	52.0%	50.0%	.03†
Lifetime major depression	34.9%	21.3%	40.8%	66.7%	.003†
Lifetime substance abuse	36.4%	29.0%	42.9%	33.3%	.23†
Lifetime anxiety disorder	22.4%	12.9%	21.8%	75.0%	.0001†

* P value based on 1-way analysis of variance.
† P value based on χ^2 test.
‡ Lifetime health conditions.
§ Symptoms in the past month.

ger landed between the other 2 groups. Preschool-aged children with severe hunger also had more health conditions in the past year (2.8 vs 1.9 for the no hunger group and 2.6 for the modest hunger group) and higher CBCL internalizing scores. Three fourths of preschool-aged children with severe hunger had been homeless, but small cell sizes render this bivariate comparison between hunger and homelessness nonsignificant.

Mothers of school-aged children who reported severe hunger were more likely to have a lifetime diagnosis of posttraumatic stress disorder or substance abuse (Table 2). However, the rates of depression were similar (and high) among all 3 groups of school-aged mothers. Mothers of preschool-aged children who reported severe hunger had high rates of major depression, posttraumatic stress disorder, and anxiety disorders (Table 2). There was no difference in this group in terms of substance abuse.

Table 3 displays the results of a multivariate model of mother-reported health conditions in the past year for both school-aged and preschool-aged children. For school-aged children, severe hunger was a significant predictor of the chronic conditions count after controlling for housing status, mother's distress, low birth weight, and child life events. In addition to severe child hunger, low birth weight, life events, and maternal distress were independent predictors of health conditions in school-aged children. For preschool-aged children, moderate hunger was a significant predictor of health conditions, but severe hunger was not. Mother's distress and low birth weight were independent predictors of the health conditions count in preschool-aged children.

Table 4 presents models for the CBCL internalizing global score. For both school-aged and preschool-aged children, severe child hunger was a moderate predictor of internalizing problems after controlling for the other covariates in the model. In the school-aged group, life events and mother's distress were associated with higher internalizing scores. The number of moves in the past year was also associated with anxiety in school-aged children, but it seems to be protective after controlling for housing status. In preschool-aged children, homeless boys have higher internalizing problems when compared with non-homeless boys and girls (this is depicted in the interaction term). Mother's distress and foster care placements were also predictive of higher scores.

Finally, the CBCL anxiety/depression subscale was modeled exclusively in school-aged children

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TABLE 3. Multivariate Model for Mother-Reported Child Health Conditions (School-Aged and Preschool-Aged Children)

	School-Age Parameter Estimate*	School-Age Standard Error	*P* Value	Preschool Parameter Estimate†	Preschool Standard Error	*P* Value
Intercept	0.74	0.31	.02	1.28	0.35	.0004
Homeless	−0.32	0.34	.36	0.19	0.34	.57
Mother's distress	0.80	0.26	.002	0.63	0.28	.03
Child life events	0.08	0.04	.03	—		
Low birth weight	1.35	0.38	.0005	1.42	0.73	.05
Moderate child hunger	0.17	0.29	.56	0.78	0.36	.03
Severe child hunger	1.63	0.82	.05	0.79	0.69	.25
Number	196			144		
df	6			5		
Wald test (*P* value)	4.88 (.0001)			3.67 (.004)		
Adjusted R^2	—			0.08		

* Calculated using generalized estimating equations.
† Calculated using ordinary least squares.

TABLE 4. Multivariate Model for Mother-Reported Internalizing Problems (School-Aged and Preschool-Aged Children)

	School-Age Parameter Estimate*	School-Age Standard Error	*P* Value	Preschool Parameter Estimate†	Preschool Standard Error	*P* Value
Intercept	39.94	3.12	.0001	44.52	3.5	.0001
Homeless	4.83	2.10	.02	−2.86	2.51	.26
Age	0.08	0.26	.74	−0.22	0.66	.73
Nonwhite	0.41	1.63	.80	−2.91	1.57	.07
Male	2.31	1.23	.06	−0.29	2.13	.89
Male (homeless)*	—			8.11	3.12	.01
Mother's distress	7.16	1.30	.0001	8.68	1.27	.0001
Life events count	0.50	0.21	.02			
Move in past year	−1.30	0.53	.01			
Abuse	3.15	2.04	.12			
Foster care	—			5.83	2.36	.02
Moderate child hunger	0.55	1.83	.76	2.64	1.56	.09
Severe child hunger	5.85	2.77	.03	6.11	3.01	.04
Number	209			134		
df	10			9		
Wald test (*P* value)	9.95 (.0001)			8.57 (.0001)		
Adjusted R^2	—			0.34		

* Calculated using generalized estimating equations.
† Calculated using ordinary least squares.

TABLE 5. Multivariate Model for Mother-Reported Child Anxiety for School-Aged Children

	Parameter Estimate*	Standard Error	*P* Value
Intercept	0.36	0.48	.45
Homeless	2.08	0.84	.01
Mother's distress	2.11	0.47	.0001
Child life events	0.18	0.07	.007
Child moves in past year	−0.56	0.22	.01
Child sexual abuse	1.60	0.85	.06
Ever suspended	1.51	0.82	.06
Moderate child hunger	0.41	0.54	.44
Severe child hunger	2.21	1.12	.05
Number	201		
df	8		
Wald test (*P* value)	12.11 (.0001)		

* Calculated using generalized estimating equations.

(Table 5). After controlling for housing status, mother's distress, and stressful life events, severe child hunger was associated with higher rates of mother-reported child anxiety. Other predictors include homelessness and stressful life events. Moves in the past year seemed to be similarly protective of higher anxiety scores. Maternal distress was also associated with higher anxiety in children.

DISCUSSION

With the use of data from a study of low-income housed and homeless families, the present analysis moves beyond previous reports to examine the contribution of child hunger to adverse child physical and mental health and learning outcomes, when controlling for a range of potential explanatory factors. After environmental, child, and maternal factors

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were controlled for, severe child hunger was found to be associated with higher rates of chronic illness and psychiatric distress, our primary study outcomes. In addition, families that experience multiple signs of child hunger are more likely to be homeless, experience more stressful life events, and live in families in which mothers have a lifetime diagnosis of posttraumatic stress disorder or a substance abuse problem.

Numerous studies have demonstrated the negative effects of poverty on children's health outcomes.[22–24] Findings from previous studies, conducted on a broader range of family incomes, showed that not only poverty but also factors associated with it (race, gender, education, and employment status) are related to hunger, which in turn is associated with negative health outcomes.[2,5,6,14] In our sample, the lack of variation in socioeconomic factors provided little discriminatory power to explore associations between these factors and either hunger or health outcomes. Our data set did, however, allow us to examine the impact of hunger in light of other potential explanatory factors.

The results highlight the independent relationship between severe child hunger and an increased number of chronic adverse health conditions in both preschool- and school-aged children. Children from families that reported multiple signs of child hunger (ie, severe child hunger) are significantly more likely to experience an increased number of chronic illnesses, even after controlling for a number of potential confounding variables. In contrast to the report by Alaimo et al,[6] which found that children from food-insufficient families were more likely to be reported to have poorer health status and experience more frequent headaches and stomachaches, hungry children in our sample who experienced severe hunger did not experience more acute illnesses or functional symptoms or experience differences in mothers' report of overall health status compared with children who did not experience multiple signs of hunger. The difference in findings between these 2 observational studies may be attributed to differences in sample characteristics and design, our ability to control for a larger number of potential confounding variables, and our capacity to identify multiple signs of child hunger. We unfortunately do not have data to explore the means by which hunger increases chronic illness among children. Perhaps periodic food insufficiency harms health through physiologic means. In addition, in poor female-headed families in which children experience more illness, mothers may have less time or personal resources to manage family food needs, requiring considerable focus and planning. Finally, although we controlled for children's psychological status, it may also be that child hunger creates psychological changes (eg, stress) that we failed to measure and that could result in higher illness levels.

This study also highlights the independent and negative impact of hunger on children's mental health. Hungry children are more likely to experience anxiety and depressive symptoms. A small literature has shown that hunger may impair children's psychosocial functioning[3–5] and increase the likelihood of behavioral problems.[4] The Kleinman and Murphy studies,[3,4] however, failed to examine the extent to which hunger, compared with other stressors in poor children's lives, were responsible for the observed outcomes. Alaimo et al,[5,6] although controlling for demographic and some environmental and maternal factors, did not control for child factors, used mothers' reports of children's referral to a psychologist and ability to get along with friends in lieu of a standardized measure to assess psychosocial functioning, and used a 1-item measure of family hunger that was unable to detect child hunger or multiple indicators of it.

There are a range of potential explanations for the association of hunger and anxiety in children. Food deprivation may result in physiologic or emotional changes that compromise children's mental health or ability to cope with stress. Children may also experience anxiety as a result of unpredictable and intermittent meals. Not knowing whether food needs will be met day to day can result in substantial stress. Others have reported that failure to meet basic material needs, such as housing, results in higher levels of anxiety among children.[21] Furthermore, mothers who are unable to provide sufficient food for their children may feel distressed and unsettled, which can, in turn, affect children's level of emotional well-being. Although the literature on children's development recognizes that adverse outcomes tend to result from the cumulative nature of many risk factors,[25] our data suggest that periodic hunger alone is sufficient to result in adverse outcomes.

Although this study points to the association between hunger and adverse health and mental health outcomes among children, it is important to view the impact of hunger in the broader context of interacting social forces and factors, such as maternal mental health and poverty, that may also lead to poor outcomes in children. It is possible that our study failed to measure or inadequately measured variables that may also influence children's physical and mental health.

For school-aged children, multiple moves in the past year seem to be protective, diminishing their risk of experiencing anxiety. This result is somewhat unexpected; however, given the high prevalence of domestic violence in our sample, multiple moves may reduce anxiety and depressive symptoms by decreasing exposure to such violence. It is also possible that children who have experienced greater residential stability may be more affected by a move and the resulting disruption compared with children who move frequently and may have become more accustomed to residential instability.[21]

In addition and consistent with previous research,[26,27] mothers' emotional distress and other stressful events in children's lives, such as previous foster care placement or abuse history, contribute to a child's anxiety and depression. A mother's mental health status can affect her ability to cope with the pressures of poverty and the constellation of insults associated with it. If she is compromised, then she may be less capable of buffering her children from

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both. After controlling for these maternal and environmental risk factors, however, hunger remained a significant predictor of a child's anxiety and depression.

Unlike previous studies that suggested a relationship between hunger and children's academic functioning, including poorer attendance rates,[3,4] repeated grades,[5] and poorer academic achievement,[5,6] we failed to find a similar relationship. We hypothesize that in our more narrowly defined sample of female-headed families, the lack of variation in socioeconomic status did not allow us to find any statistically significant school- or learning-related differences. In previous studies that were conducted with economically diverse samples,[3–6] it is possible that hunger may have been a proxy for poverty or conditions associated with it that were not controlled for. In addition, the measure of academic achievement that we used may not be sensitive enough to respond to short-term or periodic insults, including hunger.

We also observed child hunger to be more common in families in which mothers struggle with higher levels of emotional distress and mental health conditions, including posttraumatic stress disorder (preschool- and school-aged children), substance abuse (school-aged children), and depression and anxiety disorders (preschool-aged children). For many women in our sample, mental health and substance abuse problems are related to very high levels of reported childhood and adulthood domestic violence.[7] Mental health and substance abuse conditions may interfere with a mother's capacity to plan the purchase and preparation of food for her family, particularly in the context of limited financial resources. Adequately providing for children's nutritional needs when on a constrained budget requires sustained and focused attention for heads of family, all the more challenging in the context of emotional health problems. Furthermore, women who fear partner violence may understandably be less attuned to the task of meeting family food needs.

Several study limitations must be considered when reviewing these results. Failure to gather information about children's functional status limits our ability to assess fully the impact of hunger on children's physical health. We were not able to validate mother-reported information by reviewing medical records, school records, or data from other sources. The literature suggests, however, that mothers' perception of their children's health status is related to service use and future health and development.[28,29] In addition, only 12 preschool-aged children experienced severe hunger. This small number reduced our ability to detect all of the impact of severe hunger on this group. In addition, mothers' distress may influence their ability to recall and report episodic hunger accurately. This applies to all other mother-reported variables; however, we have no clinical reason to believe that hunger is disproportionately biased. Furthermore, although we controlled for mothers' level of emotional distress in examining our primary study outcomes, it is possible that mothers' perceptions may reflect the stress of homelessness or other conditions commonly associated with poverty and therefore may have resulted in biased reports of children's health status or anxiety levels. Past studies of urban, low-income mothers, however, demonstrated that lower mothers' ratings of their children's health are associated with more illness and higher hospitalization rates, independent of mothers' level of stress or poor mental health status.[28,29] Finally, our findings are best generalizable to mid-sized cities with similar demographics and may not accurately reflect the impact of hunger in other types of communities.

CONCLUSION

This study goes beyond previous research, identifying the separate effect of child hunger on adverse child physical and mental health outcomes. Study findings underscore the imperative for physicians to identify hungry children and to refer them to available resources and to advocate for them in the public health arena.

Although hunger is increasingly acknowledged to be associated with detrimental health, emotional, and learning outcomes, many health care providers do not ask questions to assess the presence or degree of hunger in their pediatric patients. Hunger is often hidden, even in families in which other indicators of poverty are evident. Parents may be embarrassed to admit that they are not able to provide adequate food for their children. Although the Community Child Hunger Identification Project instrument, used in this study, has also been used to identify hungry children in a number of studies, it has not been widely used by health care providers in the office or clinic. It is essential, however, that questions that elicit the presence of child hunger be asked of parents as part of the dietary history during annual health maintenance visits. Additional refinement is needed in developing a screening tool that is useful in the clinical setting and reliably predicts adverse child outcomes. Finally, clinicians must be cognizant of hunger's relationship not only to physical problems but also to adverse mental health status; when indicated, children should be referred for counseling services.

Once uncovered, the problem of hunger in families may pose a dilemma for physicians who are unaware of the resources that are available to their patients. All health care providers for children should be educated about the available school and summer feeding programs in their community so that they may encourage participation. The US Department of Agriculture, along with state Departments of Education, support programs that provide lunch and breakfast, after-school snacks, and summer meals. Unfortunately, some children and parents feel stigmatized if they participate in these programs, especially if they are eligible for free or reduced-price meals. Although the National School Lunch Program is available in 95% of schools nationwide, only 76% of these schools offer breakfast with wide variation across states.[30] Higher participation rates in school breakfast seem to be associated with efforts to include more schools, decrease the stigma associated with participation,

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educate families about the importance of breakfast, and move more schools to universal breakfast in which all students eat for free.[30] Health care providers can play a significant role by speaking positively about school nutrition programs and "referring" children to these resources. In addition, health care providers can be important in promoting awareness in their communities of the relationship between children's participation in free breakfast programs and improved health.

Although US Department of Agriculture data show that the overall number of food-insecure families fell by 12% from 1995 to 1999, families with incomes between 50% and 130% of the poverty line (approximately 31 million Americans live in these families) had a higher rate of food insecurity during that time frame.[1] Since the enactment of the 1996 Personal Responsibility and Work Opportunity Reconciliation Act (welfare reform), food stamp participation has decreased sharply (32% nationally from 1996 to 2000).[31] Although much of this drop is attributable to rising incomes or eligibility changes, some of the decline occurred because fewer eligible families participated in the program, perhaps because of confusion and misunderstanding about new rules.[32] Health care providers, along with their office staff, have an opportunity to reach eligible families, explain current requirements, and facilitate families' application for benefits.

Although a link between hunger and deleterious child outcomes has been recognized for a number of years, our study findings clearly demonstrate the significant physical and mental health consequences of child hunger. These findings are of critical importance given the high numbers of children who are at risk for receiving insufficient food and highlight the need for public policies to ensure that families, especially children, have adequate resources with which to purchase food and can gain access to a range of community-based food programs.

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