

WIC Participation and Attenuation of Stress-Related Child Health Risks of Household Food Insecurity and Caregiver Depressive Symptoms

Maureen M. Black, PhD; Anna M. Quigg, PhD; John Cook, PhD; Patrick H. Casey, MD; Diana Becker Cutts, MD; Mariana Chilton, PhD, MPH; Alan Meyers, MD, MPH; Stephanie Ettinger de Cuba, MPH; Timothy Heeren, PhD; Sharon Coleman, MS, MPH; Ruth Rose-Jacobs, ScD; Deborah A. Frank, MD

Objectives: To examine how family stressors (household food insecurity and/or caregiver depressive symptoms) relate to child health and whether participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) attenuates stress-related child health risks.

Design: Cross-sectional family stress and cumulative stress models from January 1, 2000, through December 31, 2010.

Setting: Families recruited from emergency departments and/or primary care in Baltimore, Boston, Little Rock, Los Angeles, Minneapolis, Philadelphia, and Washington, DC.

Participants: Participants included 26 950 WIC-eligible caregivers and children younger than 36 months; 55.2% were black, 29.9% were Hispanic, and 13.0% were white. Caregivers' mean age was 25.6 years; 68.6% were US-born, 64.7% had completed high school, 38.0% were married, and 36.5% were employed.

Main Exposures: Of the participants, 24.0% had household food insecurity and 24.4% had depressive symptoms; 9.1% had both stressors, 29.9% had 1 stressor, and 61.0% had neither; 89.7% were WIC participants.

Outcome Measures: Caregivers reported child health, lifetime hospitalizations, and developmental risk. Weight and length were measured. We calculated weight-for-age and length-for-age z scores and the risk of underweight or overweight. The well-child composite comprised good/excellent health, no hospitalizations, no developmental risk, and neither underweight nor overweight.

Results: In multivariate analyses adjusted for covariates, as stressors increased, odds of fair/poor health, hospitalizations, and developmental risk increased and odds of well-child status decreased. Interactions between WIC participation and stressors favored WIC participants over nonparticipants in dual stressor families on 3 child health indicators: (1) fair/poor health: WIC participants, adjusted odds ratio (aOR), 1.89 (95% CI, 1.66-2.14) vs nonparticipants, 2.35 (2.16-4.02); (2) well-child status: WIC participants, 0.73 (0.62-0.84) vs nonparticipants, 0.34 (0.21-0.54); and (3) overweight: WIC participants, 1.01 (0.88-1.16) vs nonparticipants, 1.48 (1.04-2.11) ($P=.06$).

Conclusions: As stressors increased, child health risks increased. WIC participation attenuates but does not eliminate child health risks.

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ECONOMIC HARDSHIP OCCURS among increasingly large segments of the national population, undermining children's health and well-being and leading to poor adult health, social disparities, and limited human capital.^{1,2} Although associations between economic hardship and children's poor health have been well documented,³⁻⁶ little is known about compensatory interventions to alleviate the negative consequences of economic hardship on young children.⁷

As proposed by the family stress model,^{1,2} without adequate economic resources, families must make difficult

choices among basic needs, such as food, housing, energy, and health care,⁴ often resulting in frustration and emotional distress.⁸ Emotional distress, frequently manifested as depressive symptoms, increases the number of stressors, interferes with

See also pages 452 and 485

caregiving practices, and adversely affects children's well-being.⁹⁻¹³ Evidence based on the cumulative stress model has shown that multiple stressors have a more insidious effect on children's health and development than specific stressors.¹⁴ Although instrumental support, including money or food, may alleviate some eco-

Author Affiliations are listed at the end of this article.

conomic hardship, the effects on cumulative stress and on children's well-being are less clear.¹⁵

Household food insecurity (uncertain access to enough food for all household members to sustain an active and a healthy life) is a major public health problem that has increased in prevalence during the current economic downturn. On the basis of national data, 21.8% of households with children younger than 6 years report household food insecurity.¹⁶ Household food insecurity threatens young children's well-being by increasing the risk for micronutrient deficiencies,¹⁷ hospitalizations,¹⁸ delayed development,¹⁹ and poor health.^{18,20}

Consistent with the family stress and cumulative stress models,^{1,14} a relationship between household food insecurity and caregiver depressive symptoms can undermine children's well-being.²¹⁻²³ There may be a direct pathway through the lack of adequate food quality and quantity, an indirect pathway through caregivers' depression or anxiety about low food availability, or a pathway in which household food security is threatened by caregiver depression.^{10,13} Families with both household food insecurity and caregiver depressive symptoms experience dual stressors, potentially increasing the risk to their young children's well-being.^{14,15} It is also possible that families of children in poor health may experience economic strain and anxiety, leading to household food insecurity and caregiver depressive symptoms.

In this investigation, we examine whether children raised in households with 2 stressors are more likely to experience negative health indicators than children with 1 or neither stressor and whether the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) compensates by alleviating the stress risks on child health indicators. WIC was designed to improve the health of infants and young children in low-income families by providing nutrient-rich foods and nutritional counseling. Benefits of WIC participation include a reduction in rates of anemia,²⁴ healthier weights and lengths, and a higher likelihood of being rated in good/excellent health compared with children in nonparticipating WIC-eligible families.²⁵ However, it is not known whether WIC participation alleviates the child health risks associated with household food insecurity and caregiver depressive symptoms.

We tested 2 hypotheses based on the family stress¹ and cumulative stress¹⁴ models. The first was that children experiencing both household food insecurity and caregiver depressive symptoms are more likely to have negative health indicators than children experiencing 1 or neither stressor. The second was that WIC participation attenuates the negative relationship between household food insecurity and maternal depressive symptoms with child health indicators.

METHODS

PARTICIPANTS

Children's HealthWatch is a collaborative research initiative that monitors the well-being of young children from urban medical centers serving low-income populations in Baltimore, Boston, Little Rock, Los Angeles, Minneapolis, Philadelphia, and

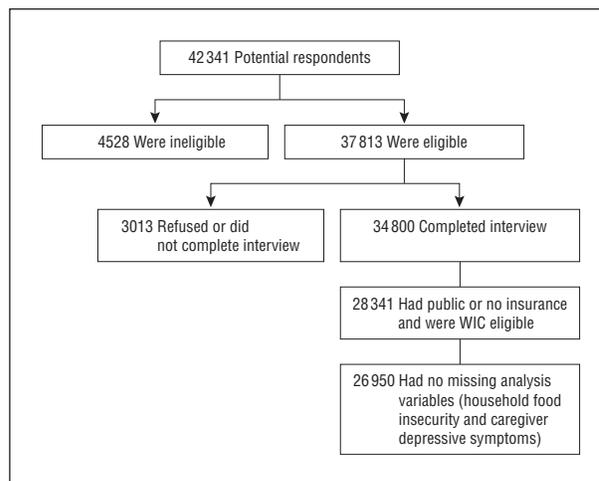


Figure. Description of analytic sample selection for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and economic hardship.

Washington, DC. During times of peak flow, interviewers approached caregivers (primarily mothers) of children younger than 36 months seeking medical services from emergency departments or primary care. Caregivers of critically ill or injured children were not approached. Caregiver eligibility included ability to speak English, Spanish, or (in Minneapolis only) Somali, state residency, and knowledge about the child's household. Data for this analysis were gathered from January 1, 2000, through December 31, 2010. Institutional review board approval was obtained at each site and renewed annually. All caregivers provided informed consent and were interviewed in private settings.

Of 42 341 caregivers approached, 4 528 (10.7%) were ineligible and 3 013 (7.1%) refused or did not complete the interview. Data from 6 459 caregivers (15.3%) with private health insurance or who reported that they were not WIC-eligible were excluded to ensure that caregivers were low income and eligible to receive WIC services. Caregivers missing data on household food security or caregiver depressive symptoms (1 391 [3.3%]) were excluded, leaving a sample of 26 950 caregiver-child pairs (**Figure**).

MEASURES

The Children's HealthWatch survey included household demographic characteristics, receipt of public assistance programs including WIC, and validated measures of household food security, caregiver depressive symptoms, and child health and development. Children were weighed and measured by hospital staff or trained interviewers.

Caregiver demographic characteristics included age, educational level, race/ethnicity, country of birth, marital status, and current employment status. Child background variables included age, sex, birth weight, prematurity, and breastfeeding history. These measures enabled us to describe the diversity of the sample and determine whether findings were confounded by these characteristics.

WIC participation was measured by asking whether the child was currently receiving WIC services. Household food insecurity was measured by the 18-item US Household Food Security Scale, administered and scored on the basis of established procedures.^{26,27} Households were classified as food insecure if their scores indicated they could not afford enough nutritious food for active, healthy lives and if this condition resulted from constrained resources.^{26,27}

Depressive symptoms were measured using a 3-item screen with a sensitivity of 100%, a specificity of 88%, and a positive predictive value of 66% compared with the 8-item Rand screening instrument.²⁸ Children's health was measured by caregiver report of lifetime hospitalizations (excluding birth) and of the single validated health status question from the third National Health and Nutrition Examination Survey.²⁹⁻³¹ Children ranked as being in fair/poor health (vs good/excellent) were considered to be in poor health.

Children's development, measured by the Parents Evaluation of Developmental Status, was added to the survey in 2004.³² Caregivers reported concerns (no, yes, or a little) about the child's development in 8 areas: expressive and receptive language, fine and gross motor, behavior, social-emotional, self-help, and school readiness, and they responded to 2 open-ended questions about concerns in global and cognitive development. *Developmental risk* was defined as having 1 or more developmental concerns.³² This measure was not administered to children younger than 4 months because sensitivity and specificity are substantially better for children aged 4 months or older.³³

Children's weight and length were collected using standard techniques and equipment. Anthropometric status was calculated on the basis of the 2000 age-sex standardized growth charts of the National Center for Health Statistics, a division of the Centers for Disease Control and Prevention.³¹ Four measures were calculated: weight-for-age and length-for-age *z* scores³⁴ and risk of underweight (weight-for-age under the 5th percentile or weight-for-length under the 10th percentile) and overweight (weight-for-age or weight-for-length above the 95th percentile for children younger than 24 months or body mass index [calculated as weight in kilograms divided by height in meters squared] above the 85th percentile for children aged 24-35 months). To examine children's overall health and developmental status, we created a well-child composite, representing children whose anthropometric status indicated risk of neither underweight nor overweight and whose caregivers from 2004 onward reported their health as good/excellent, no prior hospitalizations, and no developmental risks.⁴

OUTCOMES

Child health indicators (described in the "Measures" subsection of the "Methods" section) were the outcome variables. Weight-for-age and length-for-age *z* scores were expressed as continuous variables; all others were expressed as 2-level categorical variables.

STATISTICAL ANALYSIS

To test the hypotheses, we used multivariate logistic regression models (SAS, version 9.1; SAS Institute, Inc) for the categorical variables and multivariate linear regression models for the continuous variables (weight-for-age and length-for-age *z* scores). Covariates were selected on theoretical grounds and empirical evidence of bivariate association with child health indicators, food insecurity, or caregiver depressive symptoms. To test the first hypothesis (that children experiencing 2 stressors are more likely to have negative health indicators than children experiencing 1 or neither stressor), we examined differences in the odds of children's health indicators on the basis of exposure to 0, 1, or 2 stressors. Significance was set at $P \leq .05$.

To test the second hypothesis (that WIC participation attenuates the relationship of stressors [household food insecurity and caregiver depressive symptoms] with child health indicators), we designed the analysis on the basis of family stress¹ and cumulative stress models.¹⁴ We tested the interactions between WIC participation and 3 combinations of stressors: 1

stressor vs zero, 2 stressors vs 1, and 2 stressors vs 0 or 1. The analyses were stratified by WIC participation and the number of stressors.³⁵ All models were adjusted for site; caregiver's age, educational level, race/ethnicity, country of birth (United States vs other), marital status, and employment; and child's age, breastfeeding history (yes/no), and birth weight of 2500 g or less.

RESULTS

The mean (SD) age of the children was 11.3 (9.6) months; 53.2% were boys, 14.2% were low birth weight, and 55.9% were breastfed. Most were black (55.2%) or Hispanic (29.9%), 13.0% were white, and the remainder were from other racial/ethnic groups. The mean (SD) age of the caregivers was 25.6 (5.9) years; 68.6% were US-born, 64.7% had completed high school or beyond, 38.0% were married or living with a partner, and 36.5% were employed (**Table 1**).

One-quarter of the caregivers (24.0%) reported household food insecurity, and one-quarter (24.4%) reported depressive symptoms. The 2 stressors were correlated ($r=0.19$; $P < .001$); 9.1% of families experienced both stressors, 29.9% experienced 1 stressor, and 61.0% experienced neither.

In unadjusted analyses, there were significant differences in child health, hospitalizations, developmental risk, and well-child status on the basis of the number of family stressors (**Table 2**). These approximated a linear pattern, with progressively worse outcomes as the number of stressors increased.

When household food insecurity and depressive symptoms were considered as individual stressors in multivariate analyses adjusted for potential confounders, the adjusted odds of fair/poor health (adjusted odds ratio [aOR], 1.54 [95% CI, 1.37-1.74] and 1.62 [1.46-1.81], respectively) and of developmental risk (1.22 [1.22-1.69] and 1.69 [1.47-1.94], respectively) were elevated to a similar degree. For depressive symptoms but not for household food insecurity, the adjusted odds of hospitalizations were elevated (aOR, 1.44 [95% CI, 1.22-1.69]) and the adjusted odds for the well-child category were reduced (0.78 [0.70-0.86]).

In multivariate analyses adjusted for potential confounders, the odds of the child's fair/poor health, prior hospitalization, and developmental risk were significantly elevated in the presence of stressors. The increase differed significantly for fair/poor health and developmental risk as the number of stressors increased from 1 to 2 (**Table 3**). The odds of being in the well-child category were reduced 14% with the increase from zero to 1 stressor (aOR, 0.86 [95% CI, 0.79-0.94]) and 24% with the increase from 1 stressor to 2 stressors (0.76 [0.66-0.89]). None of the growth indicators related to stressors singly or in combination (Table 3).

Most families (89.7%) were WIC participants. Non-participants ($n=2723$) were statistically significantly more likely to report 1 stressor (either food insecurity or depressive symptoms, 34.0% vs 29.5%) and 2 stressors (11.1% vs 8.8%; $\chi^2=47.25$; $P < .001$) than WIC participants.

The interactions between WIC participation and 1 stressor vs zero were statistically significant for devel-

Table 1. Sample Characteristics of 26 950 Caregiver-Child Pairs Based on Cumulative Stress^a

Characteristic	0 Stressor (n=16 454)	1 Stressor (n=8050) ^b	2 Stressors (n=2446)	P Value
Site				
Baltimore	2766 (16.8)	948 (11.8)	259 (10.6)	<.001
Boston	4390 (26.7)	1942 (24.1)	735 (30.0)	
Little Rock	2959 (18.0)	1452 (18.0)	397 (16.2)	
Los Angeles	484 (2.9)	177 (2.2)	52 (2.1)	
Minneapolis	3669 (22.3)	2458 (30.5)	683 (27.9)	
Washington, DC	152 (0.9)	103 (1.3)	33 (1.3)	
Philadelphia	2034 (12.4)	970 (12.0)	287 (11.7)	
Child				
Age, mean (SD), mo	11.1 (9.5)	11.5 (9.6)	12.2 (9.8)	<.001
Male sex	8785 (53.4)	4243 (52.7)	1310 (53.6)	0.56
Breastfed	8772 (53.3)	4778 (59.4)	1525 (62.3)	<.001
Low birth weight (≤2500 g)	2266 (13.8)	1181 (14.7)	367 (15.0)	.07
Race/ethnicity				
Asian	209 (1.3)	69 (0.9)	13 (0.5)	<.001
Black	9692 (58.9)	4021 (50.0)	1119 (45.7)	
Hispanic	4136 (25.1)	2941 (36.5)	964 (39.4)	
White	2247 (13.7)	932 (11.6)	303 (12.4)	
Native American	113 (0.7)	61 (0.8)	37 (1.5)	
Caregiver				
Age, mean (SD), y	25.3 (5.8)	26.0 (6.0)	26.7 (6.0)	<.001
US-born	11 850 (72.0)	5036 (62.6)	1549 (63.3)	<.001
Married	6171 (37.5)	3213 (39.9)	824 (33.7)	<.001
Educational level				
Never/elementary/some high school	5239 (31.8)	3161 (39.3)	1013 (41.4)	<.001
High school	6905 (42.0)	3136 (39.0)	860 (35.2)	
Technical school/college graduate/master's degree	4217 (25.6)	1705 (21.2)	557 (22.8)	
Employed	6470 (39.3)	2616 (32.5)	718 (29.4)	<.001

^aData are given as number (percentage) unless otherwise indicated. The study excluded families with private insurance and families who were ineligible to participate in the Special Supplemental Nutrition Program for Women, Infants, and Children.

^bAmong families with 1 stressor, 4120 (51.2%) report caregiver depressive symptoms and 3930 (48.8%) report household food insecurity.

Table 2. Unadjusted Analysis Between Cumulative Stress and Child Health Indicators for 26 950 Caregiver-Child Pairs^a

Variable	0 Stressor (n=16 454)	1 Stressor (n=8050)	2 Stressors (n=2446)	P Value
Child health, fair/poor	1492 (9.1)	1131 (14.0)	482 (19.7)	<.001
Prior hospitalization	3521 (21.4)	1917 (23.8)	679 (27.8)	<.001
Developmental risk (n=12 624)	964 (12.5)	678 (17.9)	289 (25.6)	<.001
Weight-for-age z score, mean (SD)	-.038 (1.3)	-.020 (1.3)	.001 (1.4)	.32
Length-for-age z score, mean (SD)	-.110 (1.4)	-.126 (1.4)	-.109 (1.4)	.79
At risk for underweight	2475 (15.6)	1146 (14.7)	368 (15.6)	.18
Overweight	2211 (13.9)	1081 (13.8)	362 (15.3)	.16
Well-child status ^b	3251 (42.2)	1455 (38.4)	362 (32.1)	<.001

^aData are given as number (percentage) unless otherwise indicated. Data are missing for some children.

^bComposite of no hospitalizations, not at risk of underweight, not overweight, good/excellent child health, and no developmental risk.

opmental risk, with elevated risk among WIC participants (aOR, 1.71 [95% CI, 1.51-1.94]) and with no significant difference for nonparticipants (**Table 4**). The interactions between WIC participation and 2 stressors vs 1 stressor were statistically significant for fair/poor health and well-child status (Table 4). In both cases, child health risks were elevated for children in 2-stressor families. However, the adjusted odds were more favorable for WIC participants than nonparticipants: fair/poor health: WIC participants, 1.40 (95% CI, 1.22-1.60) and nonparticipants, 2.35 (1.66-3.33); and well-child status: WIC participants, 0.82 (0.70-0.96) and nonparticipants, 0.34

(0.20-0.58). The interactions between WIC participation and 2 stressors vs zero or 1 stressor were statistically significant for fair/poor health, well-child status, and weight-for-age z scores and were marginally significant for overweight ($P=.06$) (Table 4). The stratified analyses and nonoverlapping confidence intervals showed that, although children in 2-stressor families compared with those in zero or 1-stressor families had higher adjusted odds of fair/poor health (WIC participants: 1.89 [95% CI, 1.66-2.14] and nonparticipants: 2.35 [2.16-4.02]), the odds were significantly lower among WIC participants. Similarly, children in 2-stressor families had reduced ad-

Table 3. Adjusted Odds Ratios Between Stressors and Child Health Indicators From Multiple Logistic Regression Analyses for 26 950 Caregiver-Child Pairs^a

Variable	1 Stressor vs 0 Stressor	2 Stressors vs 1 Stressor	2 Stressors vs 1 or 0 Stressor
Child health fair/poor	1.59 (1.45-1.74)	1.55 (1.36-1.75)	2.45 (2.17-2.77)
Hospitalizations	1.13 (1.05-1.21)	1.20 (1.08-1.34)	1.35 (1.22-1.50)
Developmental risk Children ≥4 mo (n=12 624)	1.58 (1.41-1.78)	1.57 (1.33-1.86)	2.49 (2.12-2.93)
Weight-for-age z score Ismean, SEM	-.013 (.01) vs -.037 (.01)	-.015 (.03) vs -.013 (.01)	-.015 (.03) vs -.037 (.01)
P Value	.17	.93	.44
Length-for-age z score Ismean, SEM	-.113 (.02) vs -.140 (.01)	-.126 (.03) vs -.113 (.02)	-.126 (.03) vs -.140 (.01)
P Value	.24	.74	.69
At risk for underweight	0.93 (0.86-1.01)	1.13 (0.99-1.30)	1.05 (0.92-1.20)
Overweight	0.97 (0.89-1.05)	1.08 (0.94-1.24)	1.05 (0.92-1.19)
Well-child status ^b	0.86 (0.79-0.94)	0.76 (0.66-0.89)	0.66 (0.57-0.76)

Abbreviation: Ismean, least square mean.

^aData are given as adjusted odds ratios (95% CI) unless otherwise indicated. Adjusted for site, US-born mother vs immigrant, race/ethnicity, marital status, caregiver educational level, breastfeeding, birth weight greater than 2500 g, caregiver employment, child age, and mother's age.

^bComposite of no hospitalizations, not at risk of underweight, not overweight, good/excellent child health, and no developmental risk.

Table 4. Association Between Cumulative Stress and Child Health Indicators by WIC Participation^a

Variable	1 Stressor vs 0 Stressor		2 Stressors vs 1 Stressor		2 Stressors vs 1 or 0 Stressor	
	WIC (n=21 567)	No WIC (n=2422)	WIC (n=9073)	No WIC (n=1226)	WIC (n=23 661)	No WIC (n=2723)
Child health fair/poor	1.62 (1.48-1.79)	1.49 (1.13-1.96)	1.40 (1.22-1.60)	2.35 (1.66-3.33) ^b	1.89 (1.66-2.14)	2.35 (2.16-4.02) ^b
Hospitalizations	1.13 (1.05-1.21)	1.30 (1.05-1.60)	1.18 (1.05-1.33)	1.16 (0.85-1.60)	1.29 (1.16-1.44)	1.40 (1.05-1.87)
At risk for underweight	0.92 (0.84-1.01)	1.04 (0.81-1.33)	1.18 (1.02-1.37)	0.90 (0.69-1.37)	1.10 (0.96-1.26)	0.91 (0.61-1.34)
Overweight	0.96 (0.87-1.05)	1.02 (0.78-1.33)	1.04 (0.90-1.21)	1.41 (0.95-2.09)	1.01 (0.88-1.16)	1.48 (1.04-2.11) ^c
Well-child status ^d	0.83 (0.76-0.92)	0.87 (0.66-1.15)	0.82 (0.70-0.96)	0.34 (0.20-0.58) ^b	0.73 (0.62-0.84)	0.34 (0.21-0.54) ^b
PEDS—significant concerns Children ≥4 mo (n=11 106)	1.71 (1.51-1.94)	1.18 (0.84-1.66) ^b	1.52 (1.26-1.83)	1.93 (1.19-3.14)	2.12 (1.79-2.51)	2.03 (1.32-3.11)
Weight-for-age z score Ismean, SEM	-.004 (.01) vs -.022 (.01)	-.104 (.04) vs -.171 (.03)	-.020 (.03) vs -.001 (.02)	-.007 (.08) vs -.090 (.04)	-.016 (.03) vs -.015 (.01)	-.019 (.07) vs -.142 (.02) ^b
P Value	.36	.21	.56	.35	.96	.13
Length-for-age z score Ismean, SEM	-.108 (.02) vs -.137 (.01)	-.151 (.04) vs -.193 (.05)	-.143 (.04) vs -.122 (.02)	-.055 (.10) vs -.150 (.05)	-.124 (.01) vs -.127 (.01)	-.075 (.10) vs -.178 (.03)
P Value	.25	.54	.62	.38	.93	.31

Abbreviations: Ismean, least square mean; PEDS, Parents Evaluation of Developmental Status; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

^aData are given as adjusted odds ratios (95% CI) unless otherwise indicated. Adjusted for site, US-born mother vs immigrant, race/ethnicity, marital status, caregiver educational level, breastfeeding, birth weight greater than 2500 g, caregiver employment, child age, and mother's age.

^bSignificant interaction ($P=.05$).

^cBorderline significance ($P=.06$).

^dComposite of no hospitalizations, not at risk of underweight, not overweight, good/excellent child health, and no developmental risk.

justed odds of being in the well-child category, 27% for WIC participants and 66% for nonparticipants (WIC participants: 0.73 [95% CI, 0.62-0.84], nonparticipants: 0.34, [0.21-0.54]). The adjusted odds of overweight were not significant among WIC participants but were elevated among nonparticipants: 1.48 [95% CI, 1.04-2.11]. The stratified analysis showed no significant difference between stressors and weight-for-age z scores by WIC participation. Children in 2-stressor families had significantly greater odds of hospitalizations and developmental risk compared with zero- or 1-stressor families, regardless of WIC participation.

COMMENT

The increasing prevalence of household food insecurity means that many young children do not have access to adequate food.¹⁵ Findings from this investigation illustrated that not only did caregiver depressive symptoms often accompany household food insecurity, but also, in keeping with family stress and cumulative stress models,^{1,14} 2 stressors increased the likelihood of multiple negative child health indicators, including fair/poor health, hospitalizations, and devel-

opmental risk and decreased the likelihood of meeting well-child criteria.

WIC PARTICIPATION

There were 2 major findings related to WIC participation. First, WIC participants were less likely to report household food insecurity and depressive symptoms compared with nonparticipants. Others have also found that WIC participation can reduce the likelihood of household food insecurity³⁶ and that caregiver depressive symptoms can be reduced by poverty alleviation and family-oriented programs that are not specifically designed to address mental health problems.³⁷⁻³⁹ The WIC program provides nutritious food and advice; these services are designed to reduce household food insecurity, support healthy feeding behavior, and promote child health.

Second, WIC participation attenuated but did not eliminate the negative relationship between stressors and child health indicators, especially among dual-stressor families. Among families with both stressors, children of WIC participants were less likely to be perceived as having fair/poor health and more likely to meet the well-child criteria than children of nonparticipants. WIC services are directed toward children's nutrition, perhaps enabling families to promote their children's health and nutrition regardless of other family stressors. Thus, evidence from this study suggests that the benefits of WIC participation on child health indicators may operate by reducing household food insecurity and caregiver depressive symptoms and/or by enhancing children's health through the provision of healthy food and nutritional advice.

CHILD GROWTH

The finding that children in 2-stressor, non-WIC-participating households are at increased odds of experiencing overweight suggests that WIC participation may protect young children from excessive weight gain. The provision of healthy, age-appropriate food along with nutritional counseling may help families avoid the low-nutrient, high-calorie foods that are sometimes consumed by food-insecure families.⁴⁰

Although household food insecurity has been associated with undernutrition in developing countries,^{41,42} it has been associated with adult obesity in the United States.⁴³ With limited resources, families often resort to low-cost, low-nutrient food,^{40,44} resulting in high-energy, high-fat diets, thereby increasing the obesity risk. Reviews of US studies have found no evidence that food insecurity is related to children's weight status.^{45,46} However, maternal stress, including depression, but not food insecurity, has been associated with children's overweight.⁴⁷ Our findings suggest that WIC may protect young children in dual-stressor families from the risk of obesity.

METHODOLOGIC CONSIDERATIONS

There are several methodologic issues that should be considered in interpreting these findings. First, adverse selection bias is a threat to WIC-related research. WIC is a

federal grant program without entitlement status that aims to serve all eligible women, infants, and children. Although some eligible families do not participate,⁴⁸ a comparison among Medicaid recipients (all WIC eligible) showed that nonparticipants are often better off with more education and less likelihood of being single teen mothers or racial minorities than WIC participants.⁴⁹ These differences imply that biases should lean toward less optimal outcomes among children of WIC participants. In contrast, we found that WIC participation was associated with better child health indicators, thereby suggesting that our findings could even understate the positive associations between WIC participation and child health indicators. However, eligible nonparticipants may differ from participants in motivation or other unmeasured variables that could impact the health of their children. We attempted to reduce selection bias by limiting the comparison group to WIC-eligible families and by adjusting for demographic factors.

Second, the cross-sectional design does not enable us to establish causal relationships. Although our investigation was guided by the family stress and cumulative stress models,^{1,14} which conceptualize associations between economic hardship and negative child health to be at least partially explained by caregiver depressive symptoms that often accompany economic hardship, it is also possible that associations may be driven by children's health problems. Families may experience financial and emotional strain from frequent appointments, increased health care costs, and anxiety associated with having a child in poor health.

Third, the single-stressor category included either food insecurity or caregiver depressive symptoms. Although both have been linked to negative child health conditions and the significant increase in negative child health indicators from single to dual stressors supports family stress and cumulative stress models,^{1,14} the mechanisms may differ.

Fourth, many of the variables were obtained from caregiver report, raising the possibility of shared method variance. However, anthropometric status, which was included in the well-child status variable, was based on direct measurement, indicating that shared method variance cannot fully explain our findings.

Fifth, the sample was recruited from 7 urban medical centers serving low-income communities and further restricted to ensure that families were WIC eligible, thus limiting generalizability to low-income families. However, the increasing rates of poverty and food insecurity among households with children¹⁵ suggest that findings are applicable to low-income families with young children.

CONCLUSIONS

Early childhood includes the formation of neurologic, cognitive, and socioemotional building blocks that support children throughout life.⁵⁰ Inequities associated with household food insecurity and caregiver depressive symptoms disrupt these building blocks and can compromise children's functioning, resulting in lifelong negative consequences to their health and well-being. Evidence pre-

sented here illustrates that cumulative stress is associated with child health risks and that a community nutrition program (WIC) attenuates some of the child health risks associated with household food insecurity and caregiver depressive symptoms. Coordinated family-oriented policy approaches are necessary to prevent economic hardships, such as household food insecurity, to alleviate caregiver emotional distress, and to improve availability and funding for WIC.

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Author Affiliations: Department of Pediatrics, University of Maryland School of Medicine, Baltimore (Drs Black and Quigg); Department of Pediatrics, Boston University School of Medicine (Drs Cook, Meyers, Rose-Jacobs, and Frank), and Data Coordinating Center, Boston University School of Public Health (Mss Ettinger de Cuba and Coleman and Dr Heeren), Boston, Massachusetts; Department of Pediatrics, University of Arkansas for Medical Sciences, Little Rock (Dr Casey); Department of Pediatrics, Hennepin County Medical Center, Minneapolis, Minnesota (Dr Cutts); and Department of Health Management and Policy, Drexel University School of Public Health, Philadelphia, Pennsylvania (Dr Chilton).

Correspondence: Maureen M. Black, PhD, Department of Pediatrics, University of Maryland School of Medicine, 737 W Lombard St, Room 161, Baltimore, MD 21201 (mblack@peds.umaryland.edu).

Author Contributions: Drs Black, Quigg, Cook, Casey, Cutts, Chilton, Rose-Jacobs, and Frank and Ms Ettinger de Cuba had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Black, Quigg, Casey, Cutts, Chilton, Ettinger de Cuba, Heeren, and Coleman. *Acquisition of data:* Black, Quigg, Casey, Cutts, Chilton, Ettinger de Cuba, and Frank. *Analysis and interpretation of data:* Black, Cook, Cutts, Meyers, Ettinger de Cuba, Heeren, Coleman, and Rose-Jacobs. *Drafting of the manuscript for important intellectual content:* Quigg, Cook, Casey, Cutts, Chilton, Meyers, Ettinger de Cuba, Heeren, Coleman, Rose-Jacobs, and Frank. *Statistical analysis:* Cook, Heeren, and Coleman. *Obtained funding:* Ettinger de Cuba and Frank. *Administrative, technical, and material support:* Black, Quigg, Cook, Casey, Chilton, Meyers, Ettinger de Cuba, and Frank. *Study supervision:* Black, Casey, and Chilton.

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REFERENCES

1. Conger RD, Wallace LE, Sun Y, Simons RL, McLoyd VC, Brody GH. Economic pressure in African American families: a replication and extension of the family stress model. *Dev Psychol.* 2002;38(2):179-193.
2. Conroy K, Sandel M, Zuckerman B. Poverty grown up: how childhood socioeconomic status impacts adult health. *J Dev Behav Pediatr.* 2010;31(2):154-160.
3. Evans GW. The environment of childhood poverty. *Am Psychol.* 2004;59(2):77-92.
4. Frank DA, Casey PH, Black MM, et al. Cumulative hardship and wellness of low-income, young children: multisite surveillance study. *Pediatrics.* 2010;125(5):e1115-e1123. doi:10.1542/peds.2009-1078.
5. Poulton R, Caspi A, Milne BJ, et al. Association between children's experience of socioeconomic disadvantage and adult health: a life-course study. *Lancet.* 2002;360(9346):1640-1645.
6. Walker SP, Wachs TD, Gardner JM, et al; International Child Development Steering Group. Child development: risk factors for adverse outcomes in developing countries. *Lancet.* 2007;369(9556):145-157.
7. Melchior M, Moffitt TE, Milne BJ, Poulton R, Caspi A. Why do children from socioeconomically disadvantaged families suffer from poor health when they reach adulthood? a life-course study. *Am J Epidemiol.* 2007;166(8):966-974.
8. Wickrama KA, Conger RD, Lorenz FO, Jung T. Family antecedents and consequences of trajectories of depressive symptoms from adolescence to young adulthood: a life course investigation. *J Health Soc Behav.* 2008;49(4):468-483.
9. Bradley RH, Corwyn RF. Socioeconomic status and child development. *Annu Rev Psychol.* 2002;53:371-399.
10. Bronte-Tinkew J, Zaslow M, Capps R, Horowitz A, McNamara M. Food insecurity works through depression, parenting, and infant feeding to influence overweight and health in toddlers. *J Nutr.* 2007;137(9):2160-2165.
11. Conger RD, Ge X, Elder GH Jr, Lorenz FO, Simons RL. Economic stress, coercive family process, and developmental problems of adolescents. *Child Dev.* 1994;65(2 Spec No):541-561.
12. Lovejoy MC, Graczyk PA, O'Hare E, Neuman G. Maternal depression and parenting behavior: a meta-analytic review. *Clin Psychol Rev.* 2000;20(5):561-592.
13. Zaslow M, Bronte-Tinkew J, Capps R, Horowitz A, Moore KA, Weinstein D. Food security during infancy: implications for attachment and mental proficiency in toddlerhood. *Matern Child Health J.* 2009;13(1):66-80.
14. Sameroff A. *The Transactional Model of Development: How Children and Contexts Shape Each Other.* Washington, DC: American Psychological Association; 2009.
15. Conger RD, Conger KJ, Martin MJ. Socioeconomic status, family processes, and individual development. *J Marriage Fam.* 2010;72(3):685-704.
16. Coleman-Jensen A, Nord M, Andrews M, Carlson S. Household food security in the United States in 2010: Economic Research Report No. (ERR-125). US Dept of Agriculture Economic Research Service. <http://www.ers.usda.gov/Publications/err125/>. Published 2011. Accessed February 11, 2012.
17. Skalicky A, Meyers AF, Adams WG, Yang Z, Cook JT, Frank DA. Child food insecurity and iron deficiency anemia in low-income infants and toddlers in the United States. *Matern Child Health J.* 2006;10(2):177-185.
18. Cook JT, Frank DA, Berkowitz C, et al. Food insecurity is associated with adverse health outcomes among human infants and toddlers. *J Nutr.* 2004;134(6):1432-1438.
19. Rose-Jacobs R, Black MM, Casey PH, et al. Household food insecurity: associations with at-risk infant and toddler development. *Pediatrics.* 2008;121(1):65-72.
20. Kursmark M, Weitzman M. Recent findings concerning childhood food insecurity. *Curr Opin Clin Nutr Metab Care.* 2009;12(3):310-316.
21. Casey PH, Goolsby S, Berkowitz C, et al; Children's Sentinel Nutritional Assessment Program Study Group. Maternal depression, changing public assistance, food security, and child health status. *Pediatrics.* 2004;113(2):298-304.
22. Melchior M, Caspi A, Howard LM, et al. Mental health context of food insecurity: a representative cohort of families with young children. *Pediatrics.* 2009;124(4):e564-e572. doi:10.1542/peds.2009-0583.
23. Whitaker RC, Phillips SM, Orzol SM. Food insecurity and the risks of depression and anxiety in mothers and behavior problems in their preschool-aged children. *Pediatrics.* 2006;118(3):e859-e868. doi:10.1542/peds.2006-0239.

24. Yip R, Binkin NJ, Fleshood L, Trowbridge FL. Declining prevalence of anemia among low-income children in the United States. *JAMA*. 1987;258(12):1619-1623.
25. Black MM, Cutts DB, Frank DA, et al; Children's Sentinel Nutritional Assessment Program Study Group. Special Supplemental Nutrition Program for Women, Infants, and Children participation and infants' growth and health: a multisite surveillance study. *Pediatrics*. 2004;114(1):169-176.
26. Bickel G, Nord M, Price C, Hamilton W, Cook JT. *Guide to Measuring Household Food Security: Revised 2000*. Alexandria, VA: US Dept of Agriculture, Food and Nutrition Service; 2000.
27. Nord M, Andrews M, Carlson S. Household food security in the United States, 2007: Economic Research Report No. (ERR-66). US Dept of Agriculture Economic Research Service. <http://www.ers.usda.gov/publications/err66/err66.pdf>. Published 2008. Accessed February 11, 2012.
28. Kemper KJ, Babonis TR. Screening for maternal depression in pediatric clinics. *Am J Dis Child*. 1992;146(7):876-878.
29. Fox MH, Moore J, Davis R, Heintzelman R. Changes in reported health status and unmet need for children enrolling in the Kansas Children's Health Insurance Program. *Am J Public Health*. 2003;93(4):579-582.
30. Larson K, Russ SA, Crall JJ, Halfon N. Influence of multiple social risks on children's health. *Pediatrics*. 2008;121(2):337-344.
31. National Center for Health Statistics. *National Health and Nutrition Examination Survey III Data Collection Forms*. Washington, DC: US Dept of Health and Human Services; 1991.
32. Glascoe FP. *Collaborating With Parents: Using Parents' Evaluation of Developmental Status to Detect and Address Developmental and Behavioral Problems*. Nashville, TN: Ellsworth & Vandermeer Press; 1998.
33. Glascoe FP. Parents' evaluation of developmental status: how well do parents' concerns identify children with behavioral and emotional problems? *Clin Pediatr (Phila)*. 2003;42(2):133-138.
34. Kielmann AA, McCord C. Weight-for-age as an index of risk of death in children. *Lancet*. 1978;1(8076):1247-1250.
35. Cohen J, Cohen P, West SG, Aiken LS, eds. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. New York, NY: Wiley; 2003.
36. Metallinos-Katsaras E, Gorman KS, Wilde P, Kallio J. A longitudinal study of WIC participation on household food insecurity. *Matern Child Health J*. 2011;15(5):627-633.
37. Baker-Henningham H, Powell C, Walker S, Grantham-McGregor S. The effect of early stimulation on maternal depression: a cluster randomised controlled trial. *Arch Dis Child*. 2005;90(12):1230-1234.
38. Ozer EJ, Fernald LC, Weber A, Flynn EP, VanderWeele TJ. Does alleviating poverty affect mothers' depressive symptoms? a quasi-experimental investigation of Mexico's Oportunidades programme. *Int J Epidemiol*. 2011;40(6):1565-1576.
39. Surkan PJ, Kennedy CE, Hurley KM, Black MM. Maternal depression and early childhood growth in developing countries: systematic review and meta-analysis. *Bull World Health Organ*. 2011;89(8):608-615.
40. Cole N, Fox MK. Diet quality of American young children by WIC participation status: data from the National Health and Nutrition Examination Survey, 1999-2004. US Dept of Agriculture, Food and Nutrition Service, Office of Research, Nutrition and Analysis. <http://www.fns.usda.gov/ora/menu/published/wic/FILES/NHANES-WIC.pdf>. Published 2008. Accessed February 11, 2012.
41. Hackett M, Melgar-Quiñonez H, Alvarez MC. Household food insecurity associated with stunting and underweight among preschool children in Antioquia, Colombia. *Rev Panam Salud Publica*. 2009;25(6):506-510.
42. Hong R, Banta JE, Betancourt JA. Relationship between household wealth inequality and chronic childhood undernutrition in Bangladesh. *Int J Equity Health*. 2006;5:15. doi:10.1186/1475-9276-5-15.
43. Townsend MS, Pearson J, Love B, Achterberg C, Murphy SP. Food insecurity is positively related to overweight in women. *J Nutr*. 2001;131(6):1738-1745.
44. Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. *Am J Clin Nutr*. 2004;79(1):6-16.
45. Eisenmann JC, Gundersen C, Lohman BJ, Garasky S, Stewart SD. Is food insecurity related to overweight and obesity in children and adolescents? a summary of studies, 1995-2009. *Obes Rev*. 2011;12(5):e73-e83. doi:10.1111/j.1467-789X.2010.00820.x.
46. Larson NI, Story MT. Food insecurity and weight status among US children and families: a review of the literature. *Am J Prev Med*. 2011;40(2):166-173.
47. Gundersen C, Lohman BJ, Garasky S, Stewart S, Eisenmann J. Food security, maternal stressors, and overweight among low-income US children: results from the National Health and Nutrition Examination Survey (1999-2002). *Pediatrics*. 2008;122(3):e529-e540 doi:10.1542/peds.2008-0556.
48. Bitler MP, Gundersen C, Marquis G. Are WIC nonrecipients at less nutritional risk than recipients? an application of the food security measure. *Econ Perspect Pol*. 2005;27:433-438 doi:10.1111/j.1467-9353.2005.00240.x.
49. Bitler MP, Currie J. Does WIC work? the effects of WIC on pregnancy and birth outcomes. *J Policy Anal Manage*. 2005;24(1):73-91.
50. Fox SE, Levitt P, Nelson CA III. How the timing and quality of early experiences influence the development of brain architecture. *Child Dev*. 2010;81(1):28-40.