PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Cumulative Hardship and Wellness of Low-Income, Young Children: Multisite Surveillance Study

Deborah A. Frank, Patrick H. Casey, Maureen M. Black, Ruth Rose-Jacobs, Mariana Chilton, Diana Cutts, Elizabeth March, Timothy Heeren, Sharon Coleman, Stephanie Ettinger de Cuba and John T. Cook

Pediatrics published online Apr 12, 2010;
DOI: 10.1542/peds.2009-1078

Cumulative Hardship and Wellness of Low-Income, Young Children: Multisite Surveillance Study

AUTHORS: Deborah A. Frank, MD,[a] Patrick H. Casey, MD,[b] Maureen M. Black, PhD,[c] Ruth Rose-Jacobs, ScD,[a] Mariana Chilton, PhD, MPH,[d] Diana Cutts, MD,[e] Elizabeth March, MCP,[a] Timothy Heeren, PhD,[f] Sharon Coleman, MS, MPH,[f] Stephanie Ettinger de Cuba, MPH,[f] and John T. Cook, PhD[a]

[a]Department of Pediatrics, Boston Medical Center, Boston, Massachusetts; [b]Department of Pediatrics, University of Arkansas for Medical Sciences, Little Rock, Arkansas; [c]Department of Pediatrics, School of Medicine, University of Maryland, Baltimore, Maryland; [d]Department of Health Management and Policy, School of Public Health, Drexel University, Philadelphia, Pennsylvania; [e]Department of Pediatrics, Hennepin County Medical Center, Minneapolis, Minnesota; and [f]Data Coordinating Center, School of Public Health, Boston University, Boston, Massachusetts

KEY WORDS

hardship, child health, growth, development, food insecurity, housing insecurity, energy insecurity

ABBREVIATIONS

PEDS—Parents' Evaluation of Developmental Status
AOR—adjusted odds ratio
CI—confidence interval

www.pediatrics.org/cgi/doi/10.1542/peds.2009-1078

doi:10.1542/peds.2009-1078

Accepted for publication Jan 21, 2010

Address correspondence to Deborah A. Frank, MD, Boston Medical Center, Department of Pediatrics, 725 Massachusetts Ave, Mezzanine SW, Boston, MA 02118. E-mail: dafrank@bu.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

WHAT'S KNOWN ON THIS SUBJECT: Individual material hardships correlate with children's health and development. These hardships tend to cooccur but have not been evaluated simultaneously in cohorts of very young children.

WHAT THIS STUDY ADDS: This article shows that the level of a novel cumulative index of 3 prevalent hardships (food, housing, and energy insecurity) is a robust predictor of the health and development of children 4 to 36 months of age.

abstract

OBJECTIVES: The goals were to generate a cumulative hardship index and to evaluate its association with the well-being of children 4 to 36 months of age without private health insurance.

METHODS: Cross-sectional surveys were linked to anthropometric measures and medical record review at 5 urban medical centers (July 1, 2004, to December 31, 2007). Cumulative hardship index scores ranged from 0 to 6, with food, housing, and energy each contributing a possible score of 0 (secure), 1 (moderately insecure), or 2 (severely insecure) to generate scores indicating no hardship (score of 0), moderate hardship (scores of 1–3), or severe hardship (scores of 4–6). The outcome was a composite indicator of child wellness, including caregivers' reports of children's good/excellent heath, no hospitalizations, not being developmentally at risk, and anthropometric measurements within normal limits. Covariates were selected a priori and through association with predictors and outcomes.

RESULTS: Of 7141 participants, 37% reported no material hardship, 57% moderate hardship, and 6% severe hardship. Multivariate logistic regression analyses showed ordinal association between the cumulative hardship index and children's adjusted odds of wellness (severe versus no hardship, adjusted odds ratio [AOR]: 0.65 [95% confidence interval [CI]: 0.51–0.83]; severe versus moderate hardship, AOR: 0.73 [95% CI: 0.58–0.92]; moderate versus no hardship, AOR: 0.89 [95% CI: 0.79–0.99]).

CONCLUSION: Increasing levels of a composite measure of remediable adverse material conditions correlated with decreasing adjusted odds of wellness among young US children. *Pediatrics* 2010;125: e1115–e1123

Poverty during childhood exerts profound, persistent, adverse effects on health, educational achievement, and economic self-sufficiency in later life.[1,2] Rapid development in early life enhances vulnerability to even short-term physiologic perturbations (nutrient deficiency, temperature extremes, stress, infections, and toxin exposure), which are more prevalent and more severe among children living in poverty.[3,4]

Poverty in the United States disproportionately afflicts young children in households with parents who are single, are black or Hispanic, are immigrants, or have low educational attainment.[5,6] Poverty influences children's well-being through multiple broad constructs of environmental stressors. One stressor, which often is a consequence of parental psychological distress, involves unresponsive caregiving, which results in a lack of early-life cognitive stimulation.[7–9] Other stressors involve "material hardships," which may have direct physiologic effects on children. These hardships include food insecurity, unstable or crowded housing, inability to afford home heating or cooling, and lack of health insurance,[10] conditions that are measured nationally by the Survey of Income and Program Participation.[10,11] Investments in home visiting, early education, or public benefit programs may mitigate the effects of these factors.[12–16] We and others have linked individual material hardships, particularly food, housing, and energy insecurity, to the health and development of children during the first 3 years of life.[13,17–23]

Since the seminal work of Sameroff and Chandler,[24] composites of demographic and psychological characteristics have been considered better predictors of health,[25,26] IQ, and behavior[27,28] in young children than is any single factor.[25–28] For example, Sameroff et al[28] evaluated 10 demographic and psychological risk factors and found a linear relationship between the number of risk factors (up to 4 or 5) and children's preschool IQ, with little incremental effect after that threshold. In another study, a latent material hardship construct of food insecurity, housing instability, inadequate medical care, and "financial troubles" was a stronger predictor of parents' psychological distress than was income alone.[8] Food insufficiency and "medical need" correlated negatively with the health of 5- to 11-year-old children, both directly and through parental depression.[29] To our knowledge, however, there are no studies examining the association between multiple material hardships, controlling for relevant covariates, and the well-being of poor and near-poor infants and toddlers. Moreover, some components of children's well-being may be more vulnerable to varying levels of cumulative hardships than others.

The goals of the current study were to develop and to test a cumulative hardship index synthesizing 3 factors (food insecurity, energy insecurity, and housing insecurity) from data collected by Children's HealthWatch (www.childrenshealthwatch.org), formerly the Children's Sentinel Nutrition Assessment Program. We hypothesized that (1) cumulative hardship would decrease, in an ordinal manner, the odds of wellness (a summary indicator of positive health and development) among young children, while controlling for the demographic and perinatal characteristics and maternal depressive symptoms that constitute traditional risk factor indices, and (2) the threshold for negative outcomes associated with the cumulative hardship index might differ for each domain of the summary wellness indicator.

METHODS

Study Sample and Procedures

Children's HealthWatch conducted household-level surveys and medical record audits from July 1, 2004, to December 31, 2007. Institutional review board approval was obtained at each site and was renewed yearly. The subjects were recruited from primary care clinics (Baltimore, MD; and Minneapolis, MN) and hospital emergency departments (Baltimore, MD; Boston, MA; Little Rock, AR; and Philadelphia, PA). During times of peak patient flow, as staffing permitted, all caregivers of children from birth to 3 years of age who met the study criteria were approached, with the exception of caregivers of critically ill or injured children. Eligibility criteria for the current analysis included lack of private health insurance (as a proxy for low income), child's age of $\geq$4 months and $<$37 months, state residency, ability to speak English, Spanish, or (in Minneapolis only) Somali, living in the child's household, not having been interviewed within the previous 6 months, and consent to be interviewed.

Instruments

The survey included multiple domains. Child health was assessed through 2 indicators. Caregivers reported their perceptions of their children's health as fair, poor, good, or excellent, which was adapted from the single validated question from the Third National Health and Nutrition Examination Survey.[30] Children's history of lifetime hospitalizations since discharge from the newborn nursery was determined through caregivers' reports.

Developmental risk was measured with the Parents' Evaluation of Developmental Status (PEDS),[31,32] which meets the standards set by the American Academy of Pediatrics for developmental screening tests[31–34] for children from birth through age 7. We

limited our sample to children ≥4 months of age because the sensitivity and specificity of the PEDS are better for children ≥4 months of age than for younger infants.[31,32] On the basis of standard scoring of the PEDS,[31,32] endorsed items (yes or a little) were classified as significant or nonsignificant concerns depending on the age of the child. Children whose caregivers reported ≥1 significant concern were considered at developmental risk.[29,30] Caregivers' depressive symptoms were measured with a 3-item screening test,[35] which has sensitivity of 100%, specificity of 88%, and positive predictive value of 66% in comparison with the 8-item Rand screening instrument.[35]

Children's weight and length on the day of the interview either were recorded by project staff members or were determined through medical record review. Because of practical constraints within emergency departments, 25.6% of the subjects did not have their lengths measured. Weight-for-age percentiles, a composite measure of growth,[36] were calculated by using the US Centers for Disease Control and Prevention age- and gender-specific reference values.[37] When length was known, weight-for-length percentiles were ascertained and, if the child was >24 months of age, BMI percentiles were calculated.

Construction of Predictor Variable

Three constructs constitute the cumulative hardship index. Each construct generates 3 mutually exclusive categories to capture increasing levels of material hardship in the past 12 months. Household food security was derived from the valid, reliable, 18-item US Food Security Scale, which was scored and scaled in accordance with established procedures.[38] Households were classified as food insecure if they reported that they could not afford enough food for an active, healthy life for all household members.[38] Food insecurity[38] was coded as household food security, household food insecurity without child food insecurity, or household and child food insecurity. Child food insecurity indicates caregivers' report that they had to skip or to reduce the size of children's meals or to feed the children a few nutritionally unbalanced foods.[13] Child food insecurity represents an incremental risk to children's health above the risk imposed by household-level food insecurity alone.[13]

We are not aware of any officially sanctioned definitions of household housing or energy insecurity. Therefore, we measured these constructs by using indices developed empirically by Children's HealthWatch; the indices have external validity, with statistically significant associations with children's health outcomes in adjusted analyses.[20,21] Energy insecurity[20] within the past year was coded as energy security (no threatened or actual utility disconnections, no unheated/uncooled days, and no use of a cooking stove for heating), moderate energy insecurity (threatened utility disconnection because of nonpayment), or severe energy insecurity (unheated or uncooled day because of nonpayment, actual utility disconnection, and/or heating the residence with a cooking stove).

Housing insecurity[21] within the past year was categorized as housing security (no more than 1 move in the previous year and not crowded or doubled up), moderate housing insecurity (household is crowded and/or doubled up and has had no more than 1 move), or severe housing insecurity (household is crowded and/or doubled up and has moved ≥2 times). Crowding was defined as >2 people per bedroom and doubling up as a positive answer to the following question, adapted from the US Census: "Are you temporarily living with other people even for a little while because of economic difficulties?"[39]

The cumulative hardship index was constructed to range from 0 to 6, with each component (food insecurity, housing insecurity, and energy insecurity) contributing a possible score of 0 (secure), 1 (moderately insecure), or 2 (severely insecure). On the basis of the distribution of the scores, we identified 3 categories of the cumulative hardship index, that is, no hardship (score of 0), moderate hardship (scores of 1–3), and severe hardship (scores of 4–6). To evaluate whether any of the 3 components exerted a disproportionate effect on the index, we performed a multivariate logistic regression analysis with the 3 individual constructs included as separate independent variables. Adjusted odds ratios (AORs) for outcomes across the 3 constructs were of the same magnitude, with no construct consistently acting as a stronger predictor than the others.

Construction of Study Outcome Measures

By following the approach described by Bradley et al,[40] we considered children as enjoying wellness if caregivers reported that the child had good or excellent heath, had experienced no hospitalizations, and did not score as developmentally at risk on the PEDS. Furthermore, anthropometric measurements of well children fell within normal parameters (weight for age of >5th percentile but <95th percentile and weight for height of >10th percentile but <95th percentile for children <24 months of age or BMI of <85th percentile for children >24 months of age). These outcomes were shown in previous Children's HealthWatch research to correlate with the individual energy, housing, and food insecurity measures.[13,17,20–22] We also examined

the association of the cumulative hardship index with each of the individual components of this wellness index.

Statistical Methods

To test whether the cumulative hardship index acts as an ordinal scale, with increasing scores being correlated with increasing odds of adverse outcomes, we examined AORs from the multivariate logistic regression models describing not only severe versus no hardship but also severe versus moderate hardship and moderate versus no hardship. By referring to the association as "ordinal" rather than "linear," we do not assume that the increase in risk for moderate versus no hardship equals the increase in risk for severe versus moderate hardship.

Covariates were entered in the regression analysis either a priori (child's gender and birth weight) or because they were correlated at $<.05$ with both the level of hardship and the wellness outcome or its components. Two-tailed P values of $<.05$ were considered statistically significant.

RESULTS

Sample Characteristics

From 2004 through 2007, 15 100 respondents were approached to be screened for participation (Fig 1); 14 133 (94%) agreed to be screened, and 12 625 (89%) were eligible for the study. We restricted the current analysis to children 4 to 36 months of age from families with no private insurance ($N = 8324$). Of those children, 7141 (86%) had complete data on cumulative hardship and study outcomes and were included in the analyses. Children with complete data did not differ from children with incomplete data with respect to gender, age, birth weight, number of children in the household, or mother's marital status, depressive symptoms, or age. Caregivers who self-identified as Hispanic, were interviewed in Boston or Minneapolis, were not born in the United States, did not have a high school education, or did not breastfeed were more likely than other caregivers to have incomplete measures. These variables were adjusted for in the multivariate regression models.

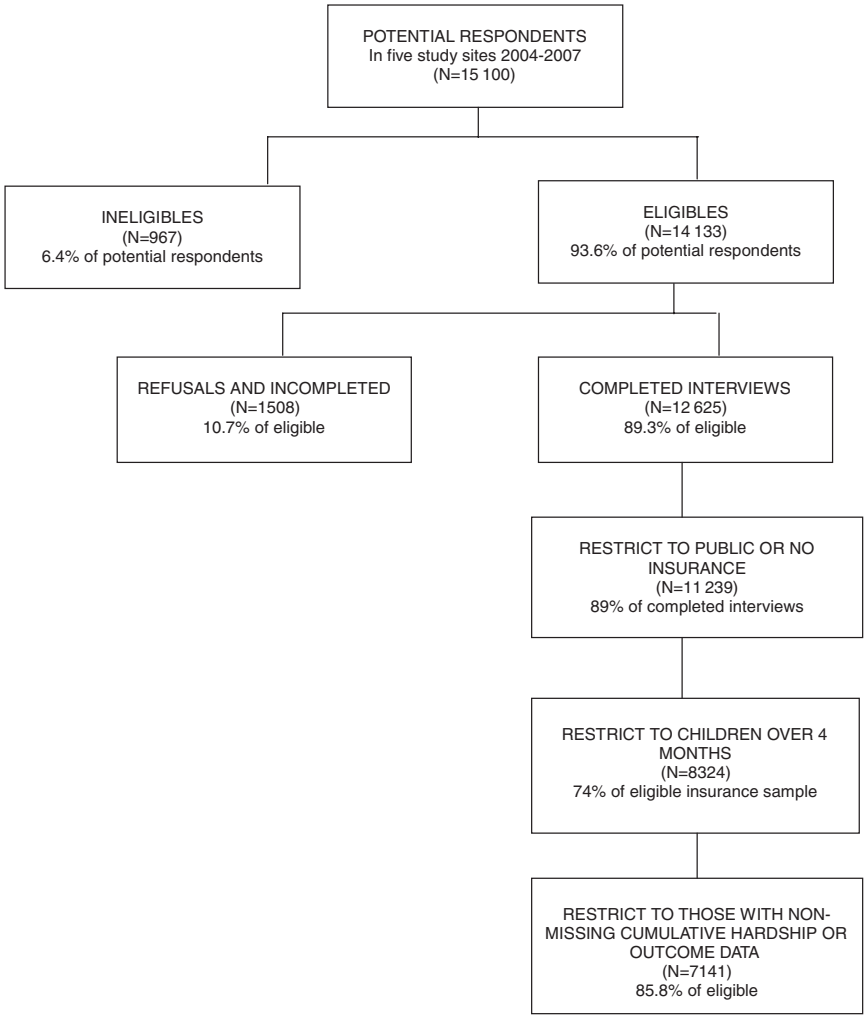

FIGURE 1
Analytic sample selection.

Thirty-seven percent of the participants reported no material hardship, 57% reported moderate hardship, and 6% reported severe hardship. The components of the cumulative hardship index were distributed as follows: (1) 79% were food secure, 10% household but not child food insecure, and 10% household and child food insecure; (2) 72% were energy secure, 14% moderately energy insecure, and 15% severely energy insecure; and (3) 59% were housing secure, 35% moderately housing insecure, and 6% severely housing insecure.

There were statistically significant differences between the 3 cumulative hardship levels and demographic characteristics, including study site, mother's self-reported race/ethnicity, place of birth, marital status, education level, employment, age, and scores on the depressive symptoms index, child's age and history of breastfeeding, and the number of children $\leq$17 years of age in the household (Table 1). The number of children $\leq$17 years of age indicates the number of

TABLE 1 Sample Characteristics According to Level of Cumulative Hardship for Infants and Toddlers of >4 Months ($N = 7141$)

	No Hardship	Moderate Hardship	Severe Hardship	*P*
N (%)	2640 (37)	4075 (57)	426 (6)	
Site, *n* (%)				<.0001
Baltimore, MD	604 (44)	720 (52)	50 (4)	
Boston, MA	651 (39)	911 (55)	109 (7)	
Little Rock, AR	516 (37)	805 (58)	70 (5)	
Minneapolis, MN	271 (23)	798 (67)	115 (10)	
Philadelphia, PA	598 (39)	841 (55)	82 (5)	
Child's gender, *n* (%)				.26
Male	1422 (38)	2120 (56)	232 (6)	
Female	1218 (36)	1955 (58)	194 (6)	
Mother's race/ethnicity, *n* (%)				<.0001
Asian	27 (38)	43 (60)	2 (3)	
Black	1568 (39)	2257 (56)	232 (6)	
Hispanic	580 (31)	1169 (62)	137 (7)	
White	446 (43)	556 (53)	45 (4)	
Native American	11 (20)	36 (67)	7 (13)	
Mother's nativity, *n* (%)				<.0001
Born in United States	2033 (39)	2893 (56)	269 (5)	
Immigrant	605 (31)	1181 (61)	157 (8)	
Mother's marital status, *n* (%)				<.0001
Married	775 (41)	987 (52)	122 (6)	
Not married	1855 (35)	3080 (59)	303 (6)	
Mother's education, *n* (%)				<.0001
Some high school	658 (30)	1363 (63)	141 (7)	
High school graduate	1164 (38)	1710 (56)	173 (6)	
College graduate	809 (43)	978 (52)	106 (6)	
Caregiver employed, *n* (%)				<.0001
Yes	1362 (42)	1705 (53)	155 (5)	
No	1275 (33)	2362 (60)	270 (7)	
Caregiver's depressive symptoms, *n* (%)				<.0001
Yes	428 (25)	1087 (64)	186 (11)	
No	2053 (41)	2785 (55)	213 (4)	
Mother's age, mean ± SD, y	26.3 ± 6.1	25.5 ± 6.0	26.9 ± 6.4	<.05
Child's age, mean ± SD, mo	16.3 ± 8.9	15.7 ± 8.9	16.1 ± 8.8	.01[a]
Child breastfed, *n* (%)				<.0001
Yes	1213 (34)	2088 (59)	253 (7)	
No	1418 (40)	1974 (55)	171 (5)	
Child's birth weight, *n* (%)				.35
Low	389 (37)	598 (58)	51 (5)	
Normal	2188 (37)	3358 (57)	357 (6)	
No. of children ≤17 y of age, mean ± SD	2.1 ± 1.1	2.5 ± 1.6	2.7 ± 1.5	<.0001

[a] Significant difference in child's age between no hardship and moderate hardship.

younger household members among whom resources need to be distributed and is distinct from the crowding definition (>2 people per bedroom) used in defining housing insecurity. All of these variables were controlled for in subsequent analyses, as were the child's birth weight and gender, because of their importance in interpreting anthropometric measurements.

Bivariate Results

In bivariate analyses, 46% of children whose caregiver reported no hardship met the study definition of wellness, compared with 42% of children experiencing moderate hardship and 35% of children experiencing severe hardship ($P = .0001$) (Table 2). When the components of wellness were evaluated separately, 11% of the children with no reported hardship were described as being in fair or poor health, compared with 13% of children with moderate hardship and 19% of children with severe hardship ($P < .0001$). Children with no or moderate hardship experienced identical rates of lifetime hospitalizations (27%), which differed marginally from the rate for children with severe hardship (33%; $P = .05$). Although the overall rates of children at risk for underweight (defined as weight for age of <5th percentile or weight for length of <10th percentile) were high, the rates did not differ significantly between groups (no hardship, 16%; moderate hardship, 14%; severe hardship, 14%; $P = .09$). However, rates of risk for overweight (defined as weight for age or weight for length of >95th percentile or BMI of >85th percentile, for children >24 months of age), which also were high, showed a marginally significant difference between hardship categories (no hardship, 16%; moderate hardship, 18%; severe hardship, 19%; $P = .05$). Rates of scoring at developmental risk on the PEDS differed significantly between hardship categories (no hard-

TABLE 2 Bivariate Prevalence of Health Outcomes According to Cumulative Hardship Status

Outcomes	*n* (%)			
	No Hardship ($N = 2640$)	Moderate Hardship ($N = 4075$)	Severe Hardship ($N = 426$)	χ^2 *P*
Well child	1209 (46)	1712 (42)	148 (35)	<.0001
Child health fair or poor	281 (11)	516 (13)	79 (19)	<.0001
Hospitalizations	723 (27)	1112 (27)	140 (33)	.05
At risk of underweight[a]	423 (16)	577 (14)	59 (14)	.09
Overweight[b]	423 (16)	746 (18)	79 (19)	.05
At developmental risk on PEDS	331 (13)	616 (15)	102 (24)	<.0001

Private insurance was excluded in all analysis, and children were ≥4 months of age.

[a] At risk of underweight was defined as weight for age of <5th percentile or weight for height of <10th percentile.

[b] Overweight was defined as weight for length of >95th percentile for children <24 months of age and BMI for age of ≥85th percentile for children ≥24 months of age. If length data were not available (25.6% of sample), then weight for age of ≥95th percentile was used as a proxy measure.

TABLE 3 Cumulative Hardship Category and Study Outcomes ($N = 7141$)

Outcomes	AOR (95% CI)		
	Severe vs No Hardship	Severe vs Moderate Hardship	Moderate vs No Hardship
Well child	0.65 (0.51–0.83)	0.74 (0.50–0.93)	0.89 (0.79–0.99)
P	<.001	.01	.03
Hospitalizations	1.18 (0.92–1.51)	1.24 (0.98–1.57)	0.95 (0.84–1.07)
P	.21	.08	.37
At developmental risk on PEDS	2.20 (1.66–2.93)	1.80 (1.38–2.34)	1.21 (1.03–1.42)
P	<.0001	<.0001	.02
Child health fair or poor	1.77 (1.30–2.41)	1.60 (1.20–2.13)	1.10 (0.92–1.30)
P	<.001	.002	.29
At risk of underweight[a]	0.90 (0.64–1.25)	1.03 (0.75–1.42)	0.88 (0.76–1.02)
P	.51	.86	.10
Overweight[b]	1.15 (0.86–1.54)	0.95 (0.72–1.26)	1.20 (1.04–1.38)
P	.36	.73	.01

Sample size reflects those without missing data for hospitalizations, at risk of underweight, overweight, child health, and PEDs as all these variables make up the well-child outcome. Private insurance has been excluded in all analysis and children are >4 months of age. Adjusted for site, race/ethnicity, us born mother vs. immigrant, marital status, education, child gender, child's age, mother's age, caregiver employment, breastfeeding, LBW, maternal depression, and number of children ≤17 years in the household.

[a] At risk of underweight was defined as weight for age of <5th percentile or weight for height of <10th percentile.

[b] Overweight was defined as weight for length of >95th percentile for children <24 months of age and BMI for age of ≥85th percentile for children ≥24 months of age. If length data were not available (25.6% of sample), then weight for age of =95th percentile was used as a proxy measure.

ship, 13%; moderate hardship, 15%; severe hardship, 24%; $P < .0001$).

Multivariate Results

As summarized in Table 3, in multivariate analyses controlling for the variables described in Table 1, we found an ordinal association between levels of the cumulative hardship index and children's decreased adjusted odds of wellness (severe versus no hardship, AOR: 0.65 [95% confidence interval [CI]: 0.51–0.83]; $P < .001$; severe versus moderate hardship, AOR: 0.73 [95% CI: 0.58–0.92]; $P = .01$; moderate versus no hardship, AOR: 0.89 [95% CI: 0.79–0.99]; $P = .03$) (Table 3). When we examined the individual components of the wellness scale in covariate controlled analyses, the 3 groups did not differ with respect to lifetime history of hospitalizations or risk of underweight. However, an ordinal association was found between cumulative hardship and developmental risk on the PEDS for severe versus no hardship (AOR: 2.20 [95% CI: 1.66–2.93]; $P <$ .0001), severe versus moderate hardship (AOR: 1.82 [95% CI: 1.40–2.38]; $P <$ .0001), and moderate versus no hardship (AOR: 1.21 [95% CI: 1.03–1.42]; $P =$ .02).

In contrast, whether caregivers reported the child's health as fair or poor versus good or excellent showed a threshold effect, such that those in the severe hardship group were more likely to be in the fair or poor health category than were those either in the no hardship (AOR: 1.77 [95% CI: 1.30–2.41]; $P < .001$) or moderate hardship (AOR: 1.61 [95% CI: 1.21–2.15]; $P = .001$) group, with no difference between the no and moderate hardship groups ($P = .29$). Children with moderate hardship were more likely to be at risk of overweight than were those with no hardship (AOR: 1.20 [95% CI: 1.04–1.38]; $P = .01$), but children with severe hardship did not differ in adjusted analyses from children with moderate or no hardship.

Separate multivariate logistic regression analyses were performed according to race/ethnicity, to explore whether the associations between cumulative hardship and adverse outcomes differed substantially according to race/ethnicity. Associations between hardship and children's wellness, hospitalizations, and PEDS developmental risk were similar across races/ethnicities (analyses available from the authors on request). Given the smaller sample sizes in these race/ethnicity-specific analyses, these findings should be considered exploratory. We evaluated whether maternal depressive symptoms were an important mediator or confounder of our findings by performing the multivariate regression analyses with and without depressive symptoms included and found that, although the results presented in Table 3 were slightly stronger when maternal depressive symptoms were not controlled for, the direction and magnitude of effects were similar (analyses available from the authors on request).

DISCUSSION

After controlling for many social/medical risk factors, including demographic and perinatal variables and caregivers' depressive symptoms, we identified an incremental effect of cumulative economic hardships on the well-being of low-income, young children. Our a priori index of cumulative hardship, derived from a synthesis of our previous studies of the individual components of food insecurity,[13,17,22] energy insecurity,[20] and housing insecurity,[21] seems, with one important exception, to approximate an ordinal index, with odds of the wellness composite and individual component adverse outcomes increasing with increasing index scores. Overweight showed a U-shaped pattern, with children with moderate hardship having greater adjusted odds of being classified as overweight, compared with those with no hardship or severe hardship. This is not an unprecedented finding; Olson[41] noted a marginal increase in BMI among low-income

women living in food-insecure households but not among women living in households experiencing severe food insecurity, as indicated by child hunger, possibly because those with moderate hardship or food insecurity are able purchase energy-dense but nutrient-poor foods, whereas those with severe food insecurity or hardship cannot even purchase adequate energy.

This cross-sectional study design can demonstrate only associations and not causation. The population studied was a sentinel sample of low-income caregivers and their 4- to 36-month-old children who were waiting for care at 1 of 5 urban primary care clinics or emergency departments. On one hand, the subjects presenting to health care settings might be at higher risk for negative health and development than low-income children in general. On the other hand, caregivers of the most seriously ill or injured children, who might have been at even higher risk, were not included because of their need for urgent care. The groups most likely to have missing data (immigrant, not breastfed, and no high school diploma or equivalent) are also those that might be at greater risk of hardship and adverse outcomes, compared with those with complete data; therefore, our estimates are conservative. The findings from this sentinel sample do not permit a simple estimation of the associations between cumulative hardship and wellness in the national population of low-income, young children. However, nationally representative survey data, which would permit such an estimate, are not currently collected. Although we controlled statistically for most of the factors used in other cumulative risk approaches (and added whether the caregiver was born in the United States), some factors were not considered. Almost all of the children in this sample had public health insurance; therefore, health insurance was not considered as a component of the cumulative hardship index. Given the constraints of acute-care medical settings, we did not include measures of the quality of the mother-child interaction or the level of stimulation in the home environment, both of which are potentially important mediators or confounders of the impact of cumulative material hardship on children's development. Ascertainment of the use of tobacco by adults in the household, which is a known correlate of poor child health that others have found to be an important correlate of food insecurity, was added to our survey only recently, and data were not available for the current analysis.[42,43] Another potential limitation is that our health outcomes solely reflect caregivers' proxy reports of children's perceived good/excellent health and lifetime hospitalizations. However, similar reports were shown by others to be valid in low-income populations with children in this age range.[44,45]

CONCLUSIONS

Food insecurity, housing insecurity, and energy insecurity, which are potentially remediable, adverse material conditions that are pervasive among low-income families in the United States, are in concert associated negatively with wellness among infants and toddlers. Although mothers' depressive symptoms were associated with the level of cumulative hardship, the statistically significant association of cumulative hardship with outcomes persisted regardless of whether such symptoms were entered into the analysis, which suggests that maternal mental health is not the primary explanatory mechanism for these results. These conditions may exert direct negative physiologic effects on children, plausibly through diets of inadequate quality or quantity, heat or cold stress, and enhanced exposure to infectious diseases or noise in crowded households. Moreover, for overall wellness, as well as specifically for developmental risk, there was an ordinal relationship, that is, severe hardship had a significantly greater impact than moderate hardship, which had a significantly greater impact than no hardship.

From a clinical perspective, pediatric providers need to consider multiple forms of hardship to assess the level of patients' risk of adverse health and developmental outcomes and to implement appropriate referrals. From a public health perspective, the current findings raise serious concerns about the future well-being of young children in the United States, given fluctuations in food and energy costs, foreclosures and evictions, and widespread job losses, with stagnant or decreasing inflation-adjusted incomes for most US families.[46–49] However, we and others have shown that there are large-scale, public programs that can either decrease the components of the cumulative hardship index or mitigate their impact on children.[50] For example, the Supplemental Nutrition Assistance Program (previously the Food Stamp Program)[13] and the Special Supplemental Nutrition Program for Women, Infants, and Children[15,51] enhance the health and growth of young children. We also have shown that housing subsidies[16] and the Low Income Home Energy Assistance Program[14] decrease the risk of young children being underweight, even in food-insecure households.

From a research perspective, future investigators should consider the level of cumulative material hardship in creating composite predictor variables for studying children. This cumulative hardship index requires replication in other age groups, in rural settings, and with varied ethnicities (eg, Native American and Asian). Additional re-

search could clarify which combination of public programs can best prevent cumulative hardship or ameliorate its impact on US children.

ACKNOWLEDGMENTS

Major funding for this research was provided by the W. K. Kellogg Foundation, with additional support from the Annie E. Casey Foundation, anonymous donors, the Anthony Spinazzola Foundation, Citizen's Energy, the Claneil Foundation, the Eos Foundation, the Paul and Phyllis Fireman Charitable Foundation, the Beatrice Fox Auerbach Foundation Fund at the Hartford Foundation for Public Giving, as directed by Jean and Vance Schiro-Zavela, General Mills, the Gryphon Fund, the Joint Center for Political and Economic Studies, the Krupp Family Foundation, the Larson Family Foundation, the New Hampshire Charitable Foundation, Susan Davies, Richard Talkov, Susan Schiro, and Peter Manus. No one working for or representing any of these sources of support played any role in any aspect of this research and article, including study concept and design; acquisition and interpretation of data; statistical analysis; drafting, review, and revision of the manuscript; administrative, technical, and material support; and study supervision.

We are very grateful to the families that participated in this study, to Zhaoyan Yang, MS, for excellent management of surveillance and interview data and SAS programming, and to Gabriela Santamaria, MA, Nicole Neault, MPH, Joni Geppert, MPH, Tu Quan, MPH, Susan Goolsby, Anna Quigg, MA, Jodi Marani, MEd, and Jennifer Breaux, MPH, for excellent training, scheduling, and supervision of interview staff members and for diligence in coding, cleaning, and preparing questionnaires for data entry.

REFERENCES

1. Duncan GJ, Brooks-Gunn J. Family poverty, welfare reform, and child development. *Child Dev*. 2000;71(1):188–196
2. Grantham-McGregor S, Cheung Y, Cueto S, Glewwe P, Richter L, Strupp B. Developmental potential in the first 5 years for children in developing countries. *Lancet*. 2007; 369(9555):60–70
3. Parker S, Greer S, Zuckerman B. Double jeopardy: the impact of poverty on early child development. *Pediatr Clin North Am*. 1988;35(6):1227–1240
4. Rodier PM. Environmental causes of central nervous system maldevelopment. *Pediatrics*. 2004;113(4 suppl):1076–1083
5. Hernandez D, ed. *Children of Immigrants: Health, Adjustment, and Public Assistance*. Washington, DC: National Academy Press; 1999
6. Capps R, Fix ME, Ost J, Reardon-Anderson J, Passel JS. *The Health and Well-Being of Young Children of Immigrants*. Washington, DC: Urban Institute; 2004
7. Bradley RH, Corwyn RF. Socioeconomic status and child development. *Annu Rev Psychol*. 2002;53:371–399
8. Gershoff ET, Aber JL, Raver CC, Lennon MC. Income is not enough: incorporating material hardship into models of income associations with parenting and child development. *Child Dev*. 2007;78(1):70–95
9. Yeung WJ, Linver MR, Brooks-Gunn J. How money matters for young children's development: parental investment and family processes. *Child Dev*. 2002;73(6): 1861–1879
10. Ouellette T, Burstein N, Long D, Beecroft E. *Measures of Material Hardship: Final Report*. Washington, DC: US Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation; 2004
11. US Census Bureau. Survey of income and program participation. Available at: www.census.gov/sipp/core_content/2001/quests/wave1/programs.html. Accessed December 22, 2009
12. Palfrey J, Hauser-Cram P, Bronson M, Warfield M, Sirin S, Chan E. The Brookline Early Education Project: a 25-year follow-up study of a family-centered early health and development intervention. *Pediatrics*. 2005; 116(1):144–152
13. Cook JT, Frank DA, Levenson SM, et al. Child food insecurity increases risks posed by household food insecurity to young children's health. *J Nutr*. 2006;136(4): 1073–1076
14. Frank DA, Neault NB, Skalicky A, et al. Heat or eat: The Low Income Home Energy Assistance Program and nutritional and health risks among children less than 3 years of age. *Pediatrics*. 2006;118(5). Available at: www.pediatrics.org/cgi/content/full/118/5/e1293
15. Black M, Cutts D, Frank DA, et al. 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
16. Meyers A, Cutts D, Frank DA, et al. Subsidized housing and children's nutritional status: data from a multisite surveillance study. *Arch Pediatr Adolesc Med*. 2005; 159(6):551–556
17. 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
18. Bronte-Tinkew J, Zaslow M, Capps R, Horowitz A. *Food Insecurity and Overweight Among Infants and Toddlers: New Insights Into a Troubling Linkage*. Washington, DC: Child Trends; 2007. Report 2007–20
19. Whitaker RC, Sarin A. Change in food security status and change in weight are not associated in urban women with preschool children. *J Nutr*. 2007;137(9):2134–2139
20. Cook J, Frank DA, Casey P, et al. A brief indicator of household energy security: associations with food security, child health and child development in US infants and toddlers. *Pediatrics*. 2008;122(4). Available at: www.pediatrics.org/cgi/content/full/122/4/e867
21. Cutts DB, Meyers AF, Black M, et al. Housing instability impacts food security and well-being in young children. Presented at the American Public Health Association 136th Annual Meeting; October 25–29, 2008; San Diego, CA
22. 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
23. 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
24. Sameroff A, Chandler M. Reproductive risk and the continuum of caretaking casualty. In: Horowitz F, Hetherington EM, Scarr-Salapatek S, Siegel G, eds. *Review of Child*

Development Research. Chicago, IL: University of Chicago Press; 1975:187–244

25. Bauman LJ, Silver EJ, Stein REK. Cumulative social disadvantage and child health. *Pediatrics*. 2006;117(4):1321–1328
26. Larson K, Russ SA, Crall JJ, Halfon N. Influence of multiple social risks on children's health. *Pediatrics*. 2008;121(2):337–344
27. Bennett D, Bendersky M, Lewis M. Children's intellectual and emotional-behavioral adjustment at 4 years as a function of cocaine exposure, maternal characteristics, and environmental risk. *Dev Psychol*. 2002;38(5):648–658
28. Sameroff AJ, Seifer R, Barocas R, Zax M, Greenspan S. Intelligence quotient scores of 4-year-old children: social-environmental risk factors. *Pediatrics*. 1987;79(3):343–350
29. Ashiabi G, O'Neal K. Children's health status: examining the associations among income poverty, material hardship, and parental factors. *PLoS ONE*. 2007;2(9):e940
30. Centers for Disease Control and Prevention. *National Health and Nutrition Examination Survey III, 1988–94*. Atlanta, GA: Centers for Disease Control and Prevention; 1994
31. Glascoe FP. Evidence-based approach to developmental and behavioral surveillance using parents' concerns. *Child Care Health Dev*. 2000;26(2):137–149
32. Glascoe FP. *Collaborating With Parents: Using Parents' Evaluation of Developmental Status to Detect and Address Developmental and Behavioral Problems*. Nashville, TN: Ellsworth and Vandermeer Press; 1998
33. American Academy of Pediatrics, Committee on Children With Disabilities. Developmental surveillance and screening of infants and young children. *Pediatrics*. 2001;108(1):192–195
34. Halfon N, Regalado M, Sareen H, et al. Assessing development in the pediatric office. *Pediatrics*. 2004;113(6 suppl):1926–1933
35. Kemper K, Babonis T. Screening for maternal depression in pediatric clinics. *Am J Dis Child*. 1992;146(7):876–878
36. Kielman A, McCord C. Weight-for-age as an index of risk of death in children. *Lancet*. 1978;311(8076):1247–1250
37. National Center for Health Statistics. *National Health and Nutrition Examination Survey: Clinical Growth Charts*. Hyattsville, MD: National Center for Health Statistics; 2008
38. Bickel G, Nord M, Price C, Hamilton W, Cook J. *Guide to Measuring Household Food Security, Revised 2000*. Alexandria, VA: US Department of Agriculture, Food and Nutrition Service; 2000
39. US Census Bureau. Historical census of housing tables: crowding. Available at: www.census.gov/hhes/www/housing/census/historic/crowding.html. Accessed December 22, 2009
40. Bradley RH, Whiteside L, Mundfrom DJ, Casey PH, Kelleher KJ, Pope SK. Early indications of resilience and their relation to experiences in the home environments of low birthweight, premature children living in poverty. *Child Dev*. 1994;65(2 spec no):346–360
41. Olson CM. Nutrition and health outcomes associated with food insecurity and hunger. *J Nutr*. 1999;129(2S suppl):521S–524S
42. Best D; American Academy of Pediatrics, Committee on Environmental Health, Committee on Native American Child Health, Committee on Adolescence. Secondhand and prenatal tobacco smoke exposure. *Pediatrics*. 2009;124(5). Available at: www.pediatrics.org/cgi/content/full/124/5/e1017
43. Cutler-Triggs C, Fryer G, Miyoshi T, Weitzman M. Increased rates and severity of child and adult food insecurity in households with adult smokers. *Arch Pediatr Adolesc Med*. 2008;162(11):1056–1062
44. Varni JW, Burwinkle TM, Seid M, Skarr D. The PedsQL 4.0 as a pediatric population health measure: feasibility, reliability, and validity. *Ambul Pediatr*. 2003;3(6):329–341
45. D'Souza-Vazirani D, Minkovitz C, Strobino D. Validity of maternal report of acute health care use for children younger than 3 years. *Arch Pediatr Adolesc Med*. 2005;159(2):167–172
46. Bernstein PL. Three strikes against consumers. *New York Times*. August 3, 2008: Available at: www.nytimes.com/2008/08/03/business/03view.html. Accessed March 21, 2010
47. National Bureau of Economic Research, Business Cycle Dating Committee. *Determination of the December 2007 Peak in Economic Activity*. Cambridge, MA: National Bureau of Economic Research; 2008
48. Bureau of Labor Statistics. Labor force statistics from the current population survey: employment situation summary. Available at: www.bls.gov/news.release/archives/empsit_01092009.pdf. Accessed January 9, 2009
49. Bureau of Labor Statistics. Consumer Price Index. Available at: www.bls.gov/cpi/. Accessed January 16, 2009
50. Lee BJ, Mackey-Bilaver L, Chin M, Majchrowicz TA. *Effects of WIC and Food Stamp Program Participation on Child Outcomes*. Washington, DC: US Department of Agriculture; 2006. Report 27.2006
51. Fox M, Hamilton W, Lin BH. Effects of food assistance and nutrition programs on nutrition and health. In: *Food Assistance and Nutrition Research Report No. 19-3*. Washington, DC: US Department of Agriculture Economic Research Service; 2004

Cumulative Hardship and Wellness of Low-Income, Young Children: Multisite Surveillance Study

Deborah A. Frank, Patrick H. Casey, Maureen M. Black, Ruth Rose-Jacobs, Mariana Chilton, Diana Cutts, Elizabeth March, Timothy Heeren, Sharon Coleman, Stephanie Ettinger de Cuba and John T. Cook

Pediatrics published online Apr 12, 2010;
DOI: 10.1542/peds.2009-1078