

Household Food Insecurity During Childhood and Subsequent Health Status: The Early Childhood Longitudinal Study—Kindergarten Cohort

Jeong-Hee Ryu, PhD, MSW, and Judith S. Bartfeld, PhD

During 2008, food insecurity reached its highest rate—14.7%—since formal measurement of the condition began in the mid-1990s, and this rate has persisted through 2010.¹ Among households with children, the food-insecurity rate reached 20.2% in 2010.¹ Previous research has linked food insecurity and other measures of food-related hardship to a wide array of negative health indicators in children, including lower parent-reported measures of child health status, higher incidence of health-related limitations, and higher frequency of headaches and stomachaches.^{2–11} Much of this work is cross-sectional, however, making it difficult to ascertain causality.

Consistent with this cross-sectional framework, existing work has generally considered food hardship during a relatively short window^{2–8,11}—most commonly a 1-year period—whereas the impacts may plausibly differ with the length of exposure. Little is known about the extent to which food insecurity is transient or persistent during childhood and about the implications of differing patterns of food insecurity for child outcomes.

A notable exception is a recent study in Canada, in which Kirkpatrick et al. found that experiencing 2 or more episodes of hunger over a 10-year period was associated with lower parent-reported health status among children, after controlling for initial health status and a variety of socioeconomic characteristics.¹⁰ This is the strongest evidence to date of a causal impact of food hardships on health outcomes and the first evidence that degree of exposure plays a role. Other work has considered severity of food insecurity, with some evidence of a dose–response relationship with health outcomes, albeit in a cross-sectional context.⁵

We examined cumulative exposure to household food insecurity over a 9-year period among a national sample selected when in kindergarten and the relationship between that

Objectives. We examined long-term patterns of household food insecurity in children from kindergarten through eighth grade and the association between those patterns and children’s proxy-reported health status in eighth grade.

Methods. We obtained data from the Early Childhood Longitudinal Study—Kindergarten Cohort, a study that followed a nationally representative sample of students from kindergarten entry in 1998–1999 through eighth grade. We classified food insecurity according to the number of years of reported household food insecurity over 4 observation years. We estimated logistic regression models to estimate the association between cumulative food insecurity exposure and health outcomes.

Results. Food insecurity was generally a transient rather than a persistent condition. Persistent food insecurity over the 9-year period was associated with lower health status in eighth grade, whereas more transient food insecurity was not significantly associated with health outcomes in most models.

Conclusions. Single-year estimates substantially underestimate the share of children whose households experienced food insecurity at some point during their childhood years. Persistent food insecurity is an important public health issue for children. Policy interventions to alleviate children’s persistent food insecurity may promote child health. (*Am J Public Health.* 2012;102:e50–e55. doi: 10.2105/AJPH.2012.300971)

exposure and children’s parent-reported health status in eighth grade. We were interested in the persistence of food insecurity over an extended period, and we paid particular attention to differentiating longer-term food insecurity from more recent exposure. We also focused on isolating the impact of food insecurity from the impact of income and poverty.

METHODS

We obtained data from the longitudinal files of the public use version of the Early Childhood Longitudinal Study—Kindergarten Cohort, a large, nationally representative study that followed children for 9 years, from kindergarten entry in 1998–1999 until eighth grade in 2007. Researchers employed a multi-stage probability cluster sample design to select the Early Childhood Longitudinal Study—Kindergarten Cohort sample and collected data from children, parents (generally mothers),

and school administrators.¹² We used data from the kindergarten and third-, fifth-, and eighth-grade parent surveys. The sample for these analyses was limited to children with full information on household food-security status at all 4 time points ($n = 7326$). For the multivariate analyses, we further limited the sample to children with information on child health status in both the fall of kindergarten (baseline) and eighth grade ($n = 6651$).

Measures

Food insecurity. We assessed food insecurity using the 18-item standard US food-security scale.¹³ Consistent with established practice, we classified households as food insecure if they responded affirmatively to at least 3 of the 18 items on the household food-security scale, and we classified the remaining households as food secure. We measured food security at 4 time points: spring of kindergarten, third grade, fifth grade, and eighth grade, with the reference

period being the 12 months before the survey. We used 2 classification schemes for describing exposure to food insecurity. To characterize the persistence of food insecurity, we classified children according to the number of years of household food insecurity observed over the 4 waves, ranging from 0 to 4. To more clearly differentiate past exposure from contemporaneous exposure, we used an alternative scheme that separately classified cumulative past exposure, ranging from 0 to 3 observation years in the kindergarten, third-grade, and fifth-grade periods, as well as a separate indicator denoting food-insecurity status in eighth grade. These summary measures describe food insecurity only during the 4 years for which surveys were conducted and, therefore, do not fully characterize food insecurity over the 9-year span.

Child outcomes. Interviewers asked parents to rate the general health status of the child on a 5-point scale, ranging from poor to excellent. We created a dichotomous variable, classifying health as either high (excellent or very good) or low (poor, fair, or good). We considered children's health status at 2 time points—fall of kindergarten (wave 1) and eighth grade (wave 7). Health status in eighth grade was the outcome measure of interest, and we used health status in fall of kindergarten as a baseline measure.

Economic well-being. We used 2 measures to control for economic well-being: log mean income over the 4 observation years and number of years with household income below the poverty line. We used both measures to allow an overall income–health gradient while also ensuring that any food-insecurity impacts were clearly differentiated from poverty impacts. Parents reported income in ranges in the data. For these analyses, we estimated income as the midpoint of the range and we estimated poverty status by comparing annual income to the poverty line for the appropriate household size.

Child and household characteristics and location. Our analyses controlled for a range of child and household characteristics and location variables typically correlated with food security. We drew sociodemographic characteristics from the eighth-grade parent survey and included child's race/ethnicity, disability status, and gender; whether child had low birth weight; and highest educational level in household. To capture experiences over the

observation years that may be correlated with food insecurity, our analyses also included variables for the extent of residential mobility (measured as the number of different places the child had lived since 2000 on the basis of information provided in the third-, fifth-, and eighth-grade surveys) and the number of observation years living with a single parent. Analyses also controlled for whether the survey was conducted in a language other than English. Location variables included region and urbanicity as measured in eighth grade.

Parental depression. Some analyses also controlled for parental depression. The survey assessed parental depression by asking the respondent, "How often during the past week have you felt depressed? Would you say never, some of the time, a moderate amount of the time, or most of the time?" We entered depression as a dichotomous variable coded 1 for parents who indicated feeling depressed some, a moderate amount, or most of the time, and 0 otherwise. Because 88% of the parental respondents were mothers, this is usually an indicator of maternal depression.¹² We conducted sensitivity analyses in which we used a depression index constructed from 12 items rather than the single-item measure, with results analogous to those reported here.

Statistical Analyses

Descriptive analyses. We conducted descriptive analyses showing food-insecurity patterns over the 4 observation years. We also conducted bivariate analyses comparing health status at kindergarten and eighth grade across the various food-insecurity groups. These analyses provide an initial look at the extent to which there were baseline differences among the groups that preceded food-insecurity experience in subsequent years as well as evidence on how the groups differed by the end of the 9-year observation period.

Multivariate analyses. We estimated logistic regression models with proxy-reported health status in eighth grade as the dependent variable. We designed the modeling strategy to provide estimates of the cumulative impact of exposure to household food insecurity as of eighth grade. In particular, we designed models to assess the roles of both transient and persistent insecurity as well as to differentiate between the roles of past versus contemporaneous

exposure. The key independent variables were dummy variables denoting food-insecurity history. We estimated 4 models, which variously used the 2 classification schemes to characterize food-insecurity exposure—the first summarizing overall years of exposure and the second differentiating between past and current exposure—and which variously included or excluded controls for parental depression. The first classification scheme allowed us to assess how the total observed exposure, from kindergarten through the current (eighth-grade) year, was associated with current health status; the alternative scheme allowed us to more formally assess the role of cumulative past exposure, while holding current-year exposure constant.

All models controlled for initial health status as a means of controlling for unmeasured time-invariant variables that have a constant effect on child health status. All models also controlled for poverty history and log mean income to more precisely isolate the impact of food insecurity from impacts of poverty and economic well-being. Finally, all models included a robust set of controls for sociodemographic and location variables.

In some models, we additionally included a variable for parental depression. Previous research has shown associations among maternal depression, food insecurity,^{14,15} and reported child health status.^{3,6,11,16–19} The mother's evaluation of both her child's health and her household's food security may reflect the psychological state of the reporter.^{20,21} Controlling for self-reported depression may help to capture this underlying state. Alternatively, depression may itself result from or be exacerbated by food insecurity, in which case its inclusion in the model would reduce the observed association between food insecurity and health outcomes and make it more difficult to detect any causal impact. We variously included or excluded parental depression to assess its impact on the results.

We weighted data to adjust for sample design and survey nonresponse, using the appropriate longitudinal weights provided with the data. We converted coefficients to odds ratios (ORs). We adjusted SEs to account for complex sampling design. We estimated results using the SAS version 9.3 (SAS Institute, Cary, NC) SURVEYREG procedure.

TABLE 1—Single- and Multiple-Year Estimates of Food Insecurity Prevalence: Early Childhood Longitudinal Study—Kindergarten Cohort, United States, 1998–2007

Time Frame	% (SE)
Grade	
Kindergarten	8.76 (0.65)
3rd	7.43 (0.63)
5th	10.05 (0.86)
8th	9.65 (0.67)
Number of observation years food insecure, grades K–8	
0	79.37 (1.14)
1	10.83 (0.73)
2	5.50 (0.48)
3	3.15 (0.34)
4	1.15 (0.25)

Note. The sample size was n = 7326.

RESULTS

Table 1 shows household food-insecurity patterns over the 4 observation years of the 9-year period. The annual prevalence of household food insecurity ranged from 7.4% to 10.1% during the period. Table 1 also describes cumulative food insecurity exposure over 4 observation years rather than a single year and indicates that 79% of children were in food-secure households at all 4 time points. Conversely, only 1.2% were in food-insecure

households at all time points. The remaining children (19.5%) had households that faced periods of both food security and food insecurity. Overall, almost 21.0% of children experienced household food insecurity at least once.

Table 2 presents descriptive results for proxy-reported health status at baseline and eighth grade. Results are the percentage in very good or excellent health and are shown for the whole sample and by food-insecurity history. Results for both the baseline and eighth-grade measures suggest better health status for those without observed exposure to household food insecurity. In the case of the baseline measures, this indicates underlying differences in health that predate observed food insecurity. Among children with no household food insecurity in the current or subsequent observation years, 84.4% had very good or excellent proxy-reported health at the start of kindergarten compared with 78.5% of those with 1 year of food insecurity and 65.0% to 70.0% of those with 2, 3, or 4 years of food insecurity. By eighth grade, the health differences according to food-security history were more pronounced: 88.5% of children with no observed household food insecurity were in very good or excellent health compared with 67.0% to 79.0% of those with 1, 2, or 3 years of food insecurity and 58.1% of those with household food insecurity in all observation years.

Table 3 shows models of proxy-reported health status at eighth grade. Compared with children who were food secure at all time points, children with 3 years of reported

household food insecurity had an estimated 92% increase in their odds of lower health status, and children living in food-insecure households during all 4 observation years had an estimated 209% increase in their odds of lower health status (model 1A). Coefficients denoting less prolonged exposure to household food insecurity (1 or 2 years) were not significantly different from zero. When parental depression was included in the model (model 1B), the estimated coefficients denoting 3 or 4 years of food-insecurity exposure were slightly smaller with no loss of statistical significance; parental depression was also associated with increased odds of lower child health. In both models, higher average income significantly reduced the odds of poor, fair, or good health, whereas the number of years in poverty had no significant link to health outcomes. Having lower health at baseline was also strongly linked to lower health in eighth grade.

When cumulative past exposure was captured separately from current exposure, 1 year of past exposure in the kindergarten, third-grade, or fifth-grade years was associated with an estimated increase of 39% in the odds of lower eighth-grade health status, whereas 3 years of cumulative exposure during those years was associated with an estimated 126% increase in the odds of lower health status, compared with children in food-secure households during all 3 prior years (model 2A). Food insecurity during the current (eighth-grade) year was also associated with increased odds of lower health status. When parental depression was added to the model, only the coefficient denoting 3 years of past exposure to food insecurity remained significant. As in previous models, higher log mean income significantly reduced the odds of poor, fair, or good health. Most of the poverty history variables were insignificant, although 2 years of past poverty exposure was associated with reduced odds of lower health status (model 2B).

DISCUSSION

We examined patterns of food insecurity over the kindergarten through eighth-grade period and the association between those patterns and child health status. Food insecurity was generally transient rather than persistent

TABLE 2—Health Status by Food-Security Experience: Early Childhood Longitudinal Study—Kindergarten Cohort, United States, 1998–2007

Time Frame	No.	Very Good or Excellent Health at Baseline, % (SE)	Very Good or Excellent Health in Eighth Grade, % (SE)
Total	6651	84.14 (0.88)	85.66 (0.79)
Number of observation years food insecure, grades K–8			
0	5589	84.41 (0.84)	88.46 (0.70)
1	592	78.49* (2.59)	78.89** (2.62)
2	244	68.01** (4.77)	73.71** (3.95)
3	171	64.93** (5.47)	67.31** (4.56)
4	55	70.02 (11.30)	58.09** (9.86)

*P < .05; P < .01. Compared with children with 0 years of reported household food insecurity.

TABLE 3—Logistic Regression Model of Low Child Health Status at Eighth Grade: Early Childhood Longitudinal Study—Kindergarten Cohort, United States, 1998–2007

Effect	Model 1A, OR (95% CI)	Model 1B, OR (95% CI)	Model 2A, OR (95% CI)	Model 2B, OR (95% CI)
Low baseline health status	2.63 (2.04, 3.39)	2.60 (2.02, 3.36)	2.61 (2.02, 3.38)	2.59 (2.00, 3.35)
Number of observation years food insecure, grades K–8				
0 (Ref)	1.00	1.00		
1	1.43 (0.99, 2.05)	1.36 (0.95, 1.94)		
2	1.47 (0.94, 2.30)	1.35 (0.87, 2.09)		
3	1.92 (1.21, 3.09)	1.66 (1.04, 2.65)		
4	3.09 (1.32, 7.51)	2.79 (1.16, 6.68)		
Number of observation years food insecure, grades K–5				
0 (Ref)			1.00	1.00
1			1.39 (1.00, 1.90)	1.33 (0.96, 1.84)
2			1.13 (0.70, 1.82)	1.10 (0.69, 1.75)
3			2.26 (1.09, 4.57)	2.07 (1.01, 4.26)
Food insecure in grade 8			1.46 (1.02, 2.07)	1.33 (0.94, 1.88)
Parental depression		1.53 (1.21, 1.93)		1.51 (1.18, 1.91)
Log average income	0.54 (0.40, 0.73)	0.55 (0.41, 0.73)	0.53 (0.40, 0.72)	0.54 (0.40, 0.72)
Number of observation years poor, grades K–8				
0 (Ref)	1.00	1.00		
1	1.10 (0.70, 1.72)	1.11 (0.71, 1.75)		
2	0.67 (0.41, 1.09)	0.66 (0.41, 1.08)		
3	0.59 (0.31, 1.11)	0.60 (0.32, 1.13)		
4	0.70 (0.41, 1.19)	0.70 (0.41, 1.19)		
Number of observation years poor, grades K–5				
0 (Ref)			1.00	1.00
1			1.01 (0.64, 1.59)	1.02 (0.64, 1.62)
2			0.51 (0.30, 0.86)	0.51 (0.30, 0.87)
3			0.66 (0.39, 1.10)	0.67 (0.40, 1.11)
Poor in grade 8			1.02 (0.75, 1.40)	1.02 (0.74, 1.39)

Note. CI = confidence interval; OR = odds ratio. Analyses were adjusted for child’s race/ethnicity, child’s disability status, child’s gender, low birth weight, highest educational level in household, language interview conducted, region, urbanicity, number of years living with single parents, and number of places the child had lived since 2000. The sample size was n = 6651.

over multiple years. Thus, children were about 7 to 9 times as likely to be in a household experiencing food insecurity during any given year as they were to be in such a household throughout the whole observation period. This is broadly consistent with limited previous research showing high rates of transition from food insecurity to food security over 2-year intervals.^{22,23}

Because of the year-to-year variability, children were more than twice as likely to be in a household experiencing food insecurity at some point in the observation period as they were to be in such a household during any given year. With only 4 observation years, these results showed that more than one fifth of children lived in a food-insecure household at

some point during the 9-year span. Actual rates of exposure to household food insecurity are likely higher, given that data are not available for 5 of the 9 years. Overall, it appears that living in a household that experiences food insecurity is surprisingly common, if generally short lived, when considered over the kindergarten through eighth-grade years. Understanding the extent to which food insecurity is associated with child health status and how this association varies with the duration of exposure is of particular importance.

Our findings suggest that persistent household food insecurity during the kindergarten through eighth-grade years (or, more precisely, during those years for which we have observations) is detrimental with regard to

eighth-grade health status. Most of the previous research in this area has been cross-sectional; this is the first evidence, to our knowledge, of the long-term effects of food insecurity on childhood health status in the United States. The longitudinal framework, including controls for initial health status and measurement of food security at multiple time points, increases our confidence that the observed associations are causal. Furthermore, by controlling for average income and poverty history, our analyses more clearly isolated the specific role of food insecurity from the role of low economic resources than has typically been done. In contrast to the apparent risk associated with persistent food insecurity, we found no evidence that poverty per se was associated with

lower health, although we did find strong evidence of an overall income–health gradient.

Although broadly consistent with findings from recent Canadian research, our results suggest that adverse health effects are present at lower food hardship severity levels than described in that study.¹⁰ Our models that differentiate past exposure from more recent experiences with food insecurity—and in particular the finding that multiple years of past exposure is significantly linked to eighth-grade health outcomes even after controlling for both contemporaneously measured food insecurity and the current psychological state of the respondent—lend further support to the importance of cumulative past exposure as an important risk factor for subsequent health outcomes.

Limitations

We note important limitations to these findings. First, there may be unobserved factors that are correlated with food-security patterns while also contributing to health status. By controlling for baseline health status, we controlled for time-invariant factors that have a constant impact on health outcomes. However, despite our detailed control for time-varying variables, including poverty history, average income, household structure, and extent of residential mobility during the kindergarten through eighth-grade period, there may be other experiences correlated with food-security patterns that affect child health status differentially over time, which could lead to an overestimate of any negative relationship between food insecurity and children's health outcomes. Furthermore, there may be relevant dimensions of food insecurity that are not captured by the standard measure. For instance, it is possible that children's own perceptions of household food insecurity would be particularly salient to subsequent health outcomes, and these perceptions may differ from those of adults in the household.²⁴

Additionally, we considered only a single health measure, namely proxy-reported health status. Maternal-reported child health status is a widely used health measure that has been found to have strong predictive value with regard to subsequent adult health.²⁵ However, there are potential concerns when measuring the relationship between maternal-reported

food insecurity and maternal-reported child health, in that there may be an unobserved propensity to either overreport or underreport negative conditions.² Including self-reported parental depression as a control, as we did, mitigates this concern, as it serves as a control for the general psychological state of the reporter; nonetheless, it would be valuable to replicate this work with a range of health outcome measures.

Finally, because of the lack of food-security data for all years of the observation period, our analyses may underestimate the relationship between food security and health outcomes, in that the always food-secure group may in fact have unobserved experiences with food insecurity, thus diluting the differences between the groups. Indeed, the transient nature of food insecurity makes it highly likely that we have not fully differentiated between children who did and those who did not have such experiences during their school-age years. We therefore view our results with caution and emphasize the need for continued research to better clarify the nature of the relationships between food-security patterns and health status among children.

Conclusions

Our findings of a negative association between food insecurity and subsequent child health are of particular concern in light of the sharp increases in food insecurity evidenced in the past several years. Not only did the national food-insecurity rate among households with children jump precipitously at the start of the 2008 to 2012 global recession—from 11.1% to 14.6% between 2007 and 2008—but it also has remained high for at least the subsequent 3 years, increasing both the number of children experiencing food insecurity in their household and, potentially, the duration of that exposure.^{26,27} Findings from this study suggest that this may have a detrimental impact on the health outcomes of children in affected households. Recent research points to the potential of federal food assistance programs to reduce the risk of food insecurity among vulnerable families, with evidence that the Supplemental Nutrition Assistance Program, the School Breakfast Program, and the Summer Food Program all play beneficial roles.^{28–33} Ensuring support to these and other programs that target

vulnerable children, particularly in an economic climate that puts more families at risk for food insecurity because of high rates of poverty and unemployment, may ultimately reap benefits in the form of better health outcomes. ■

About the Authors

At the time of this study, Jeong-Hee Ryu was with the School of Social Work, University of Wisconsin, Madison. Judith S. Bartfeld is with the Institute for Research on Poverty and the Department of Consumer Science, University of Wisconsin, Madison.

Correspondence should be sent to Jeong-Hee Ryu, Department of Sociology, California State University, Northridge, 18111 Nordhoff St., Northridge, CA 91330 (e-mail: jeonghee.ryu@csun.edu). Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints" link.

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Contributors

J.-H. Ryu led in the conceptualization of the study and conducted the analyses. J.-H. Ryu and J. S. Bartfeld shared in the synthesis and interpretation of the results and in the writing.

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Human Participant Protection

The study was deemed exempt from human subjects review by the institutional review board of the University of Wisconsin, Madison because the research used publicly available secondary data with no identifiers.

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