

Household Food Insecurity and Children's Behaviour Problems: New Evidence from a Trajectories-Based Study

Jin Huang* and Michael G. Vaughn

School of Social Work, Saint Louis University, St Louis, MO 63103, USA

*Correspondence to Jin Huang, Ph.D., School of Social Work, Saint Louis University, 3550 Lindell Boulevard, St Louis, MO 63103, USA. E-mail: jhuang5@slu.edu

Abstract

This study examined the association between household food insecurity (insufficient access to adequate and nutritious food) and trajectories of externalising and internalising behaviour problems in children from kindergarten to fifth grade using longitudinal data from the Early Childhood Longitudinal Study—Kindergarten Cohort (ECLS-K), a nationally representative study in the USA. Household food insecurity was assessed using the eighteen-item standard food security scale, and children's behaviour problems were reported by teachers. Latent growth curve analysis was conducted on 7,348 children in the ECLS-K, separately for boys and girls. Following adjustment for an extensive array of confounding variables, results suggest that food insecurity generally was not associated with developmental change in children's behaviour problems. The impact of food insecurity on behaviour problems may be episodic or interact with certain developmental stages.

Keywords: Child development, externalising behaviour problem, food security, food insecurity, internalising behaviour problem

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Introduction

A growing number of children and their households live in a state of food insecurity (i.e. lack of consistent access to adequate food) in the USA. The food insecurity rate among households with children increased to decade-highs between 2008 and 2011 due to the economic crisis, and reached 21 per cent by 2011 (which equates to about eight million households with children

experiencing food insecurity) (Coleman-Jensen *et al.*, 2012). The prevalence of food insecurity is higher among disadvantaged populations. The food insecurity rate as of 2011 was 29 per cent in black households and 32 per cent in Hispanic households. Nearly 40 per cent of households headed by single females faced the challenge of food insecurity. More than 45 per cent of households with incomes equal to or less than the poverty line and 40 per cent of households with incomes at or below 185 per cent of the poverty line experienced food insecurity (Coleman-Jensen *et al.*, 2012).

A large body of literature suggested that food insecurity was negatively associated with multiple development outcomes of children (Nord, 2009). Lack of adequate nutrition may affect children's physical health. Compared to food-secure children, those experiencing food insecurity have worse overall health, higher hospitalisation rates, lower physical functions, poorer psycho-social development, higher probability of chronic health issues, and higher rates of anxiety, depression and suicide (Nord, 2009). Previous studies also demonstrated that food insecurity was associated with adverse academic and social outcomes of children (Gundersen and Kreider, 2009).

Studies have recently begun to focus on the relationship between food insecurity and children's behaviour problems broadly reflecting externalising (e.g. aggression) and internalising (e.g. sadness). Specifically, children experiencing food insecurity have been found to be more likely than other children to exhibit these behavioural problems (Alaimo *et al.*, 2001; Huang *et al.*, 2010; Kleinman *et al.*, 1998; Melchior *et al.*, 2009; Rose-Jacobs *et al.*, 2008; Slack and Yoo, 2005; Slopen *et al.*, 2010; Weinreb *et al.*, 2002; Whitaker *et al.*, 2006). This harmful association between food insecurity and children's behaviour problems has emerged from a variety of data sources, employing different statistical techniques, and appearing to be robust to different measures of food insecurity. Based on this evidence, food insecurity may be presumed as having impacts—both nutritional and non-nutritional—on children's behaviour problems.

To further detangle the relationship between food insecurity and children's behaviour problems, several longitudinal studies focused on the association between changes of food insecurity (e.g. transient or persistent food insecurity) and children's behaviour problems (Howard, 2011a, 2011b; Huang *et al.*, 2010; Jyoti *et al.*, 2005; Ryu, 2012; Zilanawala and Pilkauskas, 2012). Results from these analyses were not completely consistent. For instance, one study, which measured food insecurity based on whether households received free food or meals in the past twelve months, did not find a significant association between food insecurity and children's behaviour problems (Zilanawala and Pilkauskas, 2012). Other studies have different results by children's gender or by the way that children's social development was measured, but generally suggested that transient rather than persistent food insecurity was associated with greater levels of behaviour problems (Howard, 2011a, 2011b; Jyoti *et al.*, 2005; Ryu, 2012).

However, few studies examined the long-term development of children's behaviour problems and its association with food insecurity. To fill in this knowledge gap, this study took a unique perspective, and investigated the relationship between trajectories of externalising and internalising behaviour problems and long-term patterns of food insecurity. Differently from previous research on levels of children's behaviour problems at a specific time point, the study examined whether the change of children's behaviour problems over time was related to food insecurity. If food insecurity has long-term impacts on children's behaviour problems, children experiencing food insecurity may have a greater increase in behaviour problems over longer time frames compared to their food-secure counterparts. On the other hand, if food insecurity only has short-term impacts on children's behaviour programmes, transient food insecurity may be associated with the levels of concurrent behaviour problems, but not related to the change of behaviour problems over time. Children experiencing persistent food insecurity, however, may still have a greater increase in behaviour problems due to the accumulation of transient impacts. Thus, we hypothesise that developmental trajectories of children's behaviour problems have a gradient relationship with long-term patterns of food insecurity: children experiencing food insecurity more frequently are likely to have a greater increase in behaviour problems over time.

Methods

Data and sample selection

We examined the above hypothesis using data from the public-use files of the Early Childhood Longitudinal Study—Kindergarten Cohort (ECLS-K), a nationally representative study that was collected by the US National Center for Education Statistics and followed 21,260 children for nine years, from kindergarten entry in 1998–99 until eighth grade in 2007. Since it is an observational study based on the public-use secondary data, the research does not require human subject's approval. The ECLS-K applied a multi-stage probability cluster sample design to select the study sample and collected data from children, parents (mainly mothers), teachers and school administrators (Tourangeau *et al.*, 2009). We used the data collected in five waves: Fall—kindergarten (1998), Spring—kindergarten (1999), Spring—first grade (2000), Spring—third grade (2002) and Spring—fifth grade (2004). The ECLS-K did not collect data in 2001 and 2003. According to the survey design of the ECLS-K, teacher-reported behaviour problem scales were included in all of these five waves, and food insecurity was only measured in three waves (Spring—kindergarten (1999), Spring—third grade (2002) and Spring—fifth grade (2004)). The final analytic sample was limited to children with full information on food insecurity at three time points, with at least one valid measure of behaviour problems, and with valid information on all covariates listed below ($N = 7,348$). Sample characteristics in Fall—kindergarten (1999) are reported in Table 1.

Table 1 Weighted sample characteristics in 1998–99: Early Childhood Longitudinal Study—Kindergarten Cohort, USA, 1999–2004 ($N = 7,348$)

Variables	N (%) or Mean (SD)
<i>Child's characteristics</i>	
Male	3,708 (51.5)
Age	68.4 (4.3)
<i>Race/ethnicity</i>	
Non-Hispanic white	4,764 (60.0)
Non-Hispanic black	617 (13.9)
Hispanics	1,261 (19.3)
Others	706 (6.8)
BMI	16.3 (2.2)
General health (excellent/very good)	6,278 (83.8)
Child disability (yes)	966 (15.4)
Home language (English)	6,482 (88.6)
Child-care arrangement (non-parental care)	3,670 (50.0)
School type (public school)	5,711 (84.2)
<i>Maternal characteristics</i>	
Age	32.8 (5.8)
Age at the first birth	23.8 (5.5)
<i>Employment status</i>	
Not employed	2,219 (31.1)
Work less than 35 hours per week	1,790 (21.9)
Work 35 hours or more per week	3,339 (47.0)
<i>Education</i>	
Less than high school	469 (9.1)
High school	2,018 (31.6)
Some college	2,030 (28.5)
Four-year college and above	2,831 (30.9)
Marital status (married)	5,922 (80.6)
Parental warmth	18.2 (1.7)
Parenting stress	11.4 (3.4)
Maternal depression	17.7 (5.6)
<i>Household characteristics</i>	
Household size	4.5 (1.3)
Number of siblings	1.4 (1.1)
<i>Household income</i>	
\$0–\$25,000	1,500 (20.4)
\$25,001–\$50,000	2,277 (51.4)
\$50,001–\$100,000	2,545 (34.6)
Above \$100,000	1,026 (14.0)
<i>Region of residence</i>	
North-east	1,462 (19.9)
Mid-west	2,041 (27.8)
South	2,158 (29.4)
West	1,687 (23.0)
<i>Area of residence</i>	
Large/mid-sized city	2,691 (36.7)
Suburb/large town	2,881 (39.2)
Town/rural area	1,776 (24.2)
<i>Patterns of food insecurity</i>	
Pat.1: persistently food-secure	(81.3)
Pat.2: food-insecure in Spring—kindergarten	(3.9)
Pat.3: food-insecure in Spring—third grade	(2.5)
Pat.4: food-insecure in Spring—fifth grade	(4.8)
Pat.5: food-insecure in Spring—kindergarten and third grade	(1.0)

Pat.6: food-insecure in Spring—kindergarten and fifth grade	(2.3)
Pat.7: food-insecure in Spring—third and fifth grades	(2.3)
Pat.8: persistently food-insecure	(2.0)

Pat. = long-term patterns of food insecurity. Food insecurity was measured in three waves. Three parenting variables (i.e. parental warmth, parenting stress and maternal depression) were measured in Spring—kindergarten (1999). All other variables were measured in Fall—kindergarten (1998). Non-weighted *N* is reported in the table.

Measures

Food insecurity

Food insecurity was assessed using the eighteen-item standard US food security scale designed to capture experiences associated with inadequate quality and quantity of household food supply in the past twelve months (Bickel *et al.*, 2000). Food insecurity questions inquired about the frequency of a particular behaviour of food consumption (e.g. could not afford to eat balanced food and cut the size of meals or skip meals) with three possible responses—‘often true’, ‘sometimes true’ and ‘never true’. According to participants’ responses to these eighteen questions, households can be categorised into those with and without food insecurity (Bickel *et al.*, 2000). Households reporting ‘often true’ or ‘sometimes true’ on at least three among eighteen food insecurity questions were classified as food insecurity.

To fully characterise households’ exposure to food insecurity over the six-year span (1999–2004), we constructed binary indicator variables for eight possible patterns: persistent food security across three waves, food insecurity in one of three waves, food insecurity in two of three waves and persistent food insecurity among three waves. Food insecurity in one of three waves had three possible combinations (i.e. food insecurity in Spring—kindergarten, Spring—third grade or Spring—fifth grade), so did food insecurity in two of three waves (i.e. food insecurity in Spring—kindergarten and Spring—third grade, in Spring—kindergarten and Spring—fifth grade or in Spring—third grade and Spring—fifth grade). This classification scheme (see Table 1) has been used in prior studies to examine the relationship between food insecurity and behaviour problems (Jyoti *et al.*, 2005).

We did not categorise households based on the frequency of food insecurity among three waves (e.g. having food insecurity once or twice) because this approach is likely to overestimate the association between food insecurity and the change in children’s behaviour problems. For example, those experiencing food insecurity once in the sample included three groups: children with food insecurity only in Spring—kindergarten, Spring—third grade or Spring—fifth grade. These three groups may have a greater level of behaviour problems, respectively, in the contemporaneous wave when they were food-insecure, but not in other waves when they were food-secure. A category including all of three groups, however, may estimate a greater increase

in the change of behaviour problems over time than it is supposed to be through averaging across three groups.

Children's behaviour problems

Children's behaviour problems, including both externalising and internalising behaviour problems, were assessed by asking teachers to report how often students exhibited certain behaviours. Externalising behaviours were measured by five items on acting-out behaviours, such as arguing, fighting, getting angry, acting impulsively and disturbing ongoing activities. Internalising behaviours were assessed by four items on the apparent presence of anxiety, loneliness, low self-esteem and sadness. Adapted from an existing standardised social skill rating system (Gresham and Elliott, 1990), the scales of externalising and internalising behaviour problems ranged from 1 (never) to 4 (very often), with a greater score indicating a higher level of behaviour problems. The public-use files of the ECLS-K, however, did not provide data on any single item included in scales of the externalising and internalising behaviours, partially due to copyright issues of using the standardised scale. The teacher-reported behaviour problem measures possessed good reliability, with a baseline Cronbach's alpha value greater than 0.90 (Tourangeau *et al.*, 2009).

Control measures

In our analyses, we made use of extensive control variables collected in the first wave (Fall—kindergarten) to reduce the possibility of spurious association between food insecurity and trajectories of children's behaviour problems. The following child-specific characteristics were included in analyses: gender, age (by month), race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanics and others), body mass index (BMI), general health (excellent/very good or others), disability (yes or no), home language (English or others), child-care arrangement (non-parental care or not), school type (private or public), number of books owned by children and average television watch time per day.

Additional maternal variables were controlled for in analyses, including age, age at the first birth, employment status (not employed, less than thirty-five hours per week or greater than or equal to thirty-five hours per week), education (lower than high school, high school, some college or bachelor and above), marital status (married or others), parental warmth, parenting stress and parental depression. Ranging from 4 to 20, a five-item scale of parental warmth measured the warmth of the relationship between parents and children, including showing love, expressing affection, playing around with children and so on. The response scale of the seven-item parenting

stress was from 4 to 21, and this measure indicated the primary care-givers' feelings and perceptions about caring for children (e.g. 'Being a parent is harder than I thought it would be' and 'I feel trapped by my responsibilities as a parent'). The survey assessed parental depression (ranging from 12 to 48) by asking how often over the past week respondents experienced depressive symptoms (e.g. felt depressed, fearful and lonely).

At household level, control variables included the number of children, the overall household size, household income (\$0–\$25,000, \$25,001–\$50,000, \$50,001–\$100,000 and \$100,000 above), AFDC/TANF participation (yes or no), Food Stamps participation (yes or no), family types (two parents with siblings, two parents without siblings, one parent with siblings or one parent without siblings), region of residence (North-east, Mid-west, South or West) and area of residence (large/mid-sized city, suburb/large town or small town/rural area).

Statistical analysis

In order to examine the trajectories of children's behaviour problems, a latent growth curve analysis was conducted using Mplus 7 for both externalising and internalising behaviour problems simultaneously in the context of structural equation modelling (SEM) (Muthén and Muthén, 2012). Since male and female children may have different developmental patterns of behaviour problems, latent growth curve analysis was conducted by gender, separately.

Figure 1 depicts the conceptual model of this analysis. In latent growth curve analysis, the development of children's behaviour problems (externalising or internalising) is expressed by two latent factors: an intercept (i.e. mean initial level of behaviour problems) and a linear slope factor (i.e. linear rate of change in behaviour problems). The factor loadings from the latent intercept to the measures of children's behaviour problems were defined as 1. The factor loadings from the linear slope to the measures of children's behaviour problems were set at 0, 0.5, 1.5, 3.5 and 5.5 from wave 1 to wave 5, respectively, where the zero loading comprised Fall—kindergarten assessment and the 5.5 loading associated to Spring—fifth grade assessment. A difference of 1 between factor loadings indicates one academic year. Both latent intercepts and linear slopes were regressed on control variables mentioned above. The linear slopes were also regressed on indicators of eight long-term patterns of food insecurity, with persistent food security as the reference group. The parameters of interest in the study were the regression coefficients of food insecurity patterns on linear slopes, which indicate the association between food insecurity and changes in children's behaviour problems over time. If food insecurity did increase children's behaviour problems, either short-term or long-term, these regression coefficients should be positive and statistically significant, and also show a gradient relationship from food security to transient and persistent food insecurity.

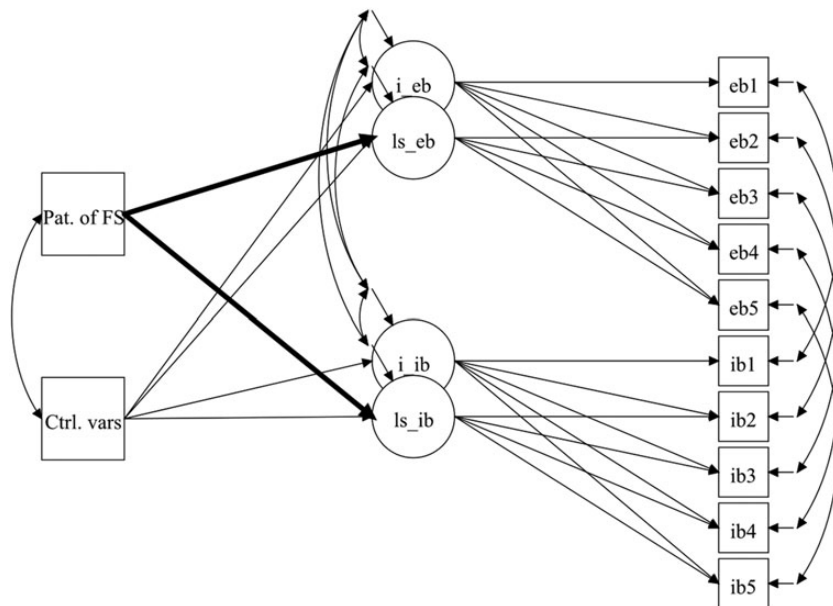


Figure 1 Structural equation model to test associations between food insecurity and trajectories of behaviour problems Pat. of FS, long-term patterns of food insecurity; Ctrl. Vars, control variables; eb, externalising behaviours; ib, internalising behaviours; *i*_eb, intercept of externalising behaviours; ls_eb, linear slope of externalising behaviours; *i*_ib, intercept of internalising behaviours; ls_ib, linear slope of internalising behaviours.

To improve model fit, we also allowed contemporaneous measures of externalising and internalising behaviours to be correlated. The missing values on the scales of children’s behaviour problems were estimated using the Full-Information Maximum Likelihood method (Muthén *et al.*, 1987; Muthén and Muthén, 2012). To adjust the estimates for the effects of complex sampling, oversampling and non-responses, all analyses were weighted using the weight variable provided by the ECLS-K data. To obtain standard errors adjusted for the effect of complex sampling and clustering of children within schools, pseudo-maximum likelihood estimation was used (Muthén and Muthén, 2012).

Results

Descriptive statistics for food insecurity

Table 1 reveals long-term patterns of food insecurity over three time points in the sample. About 80 per cent of households had persistent food security at all three time points. The prevalence of food-insecure households in any of these three waves ranged from 2.5 per cent to 4.8 per cent. Except for the situation

for households reported food insecurity in both Spring—kindergarten and Spring—third grade, which had a prevalence of nearly 1 per cent, slightly more than 2 per cent of households experienced other possible combinations of having food insecurity twice or above. Due to the small sample size of households with food insecurity in both Spring—kindergarten and Spring—third grade, we removed these households in one sensitivity analysis, and results are not different from those reported below.

Descriptive statistics for children's behaviour problems

Table 2 shows the means and standard deviations of teacher-reported externalising and internalising behaviour problems by wave. The initial means of externalising and internalising behaviours in the whole sample were 1.60 (SD = 0.65) and 1.51 (SD = 0.51), respectively. Overall, both scales increased over time. The increasing trend was continuous in internalising behaviour problems, while there were some fluctuations in externalising behaviours. The greatest change across waves was about 15 per cent of SD for externalising behaviours and 30 per cent of SD for internalising behaviours. The externalising and internalising scales of male children were higher than those of female children. Although the mean scores of externalising and internalising behaviours seem stable over waves, the intraclass correlation on externalising

Table 2 Mean and standard deviations of externalising and internalising behaviour problems by grades

	Externalising		Internalising	
	Mean	SD	Mean	SD
<i>Whole sample</i>				
Fall—kindergarten	1.60	0.65	1.51	0.51
Spring—kindergarten	1.65	0.64	1.56	0.50
Spring—first grade	1.63	0.64	1.59	0.53
Spring—third grade	1.70	0.62	1.64	0.53
Spring—fifth grade	1.65	0.59	1.64	0.55
<i>Male children</i>				
Fall—kindergarten	1.74	0.70	1.53	0.52
Spring—kindergarten	1.80	0.69	1.58	0.52
Spring—first grade	1.79	0.69	1.62	0.55
Spring—third grade	1.85	0.66	1.68	0.56
Spring—fifth grade	1.80	0.64	1.69	0.59
<i>Female children</i>				
Fall—kindergarten	1.45	0.50	1.50	0.50
Spring—kindergarten	1.49	0.53	1.53	0.48
Spring—first grade	1.48	0.55	1.55	0.50
Spring—third grade	1.55	0.52	1.59	0.49
Spring—fifth grade	1.49	0.49	1.59	0.50

The sample size ranges from 6,032 to 7,144, depending on the missing values on the scales of children's behaviour problems.

and internalising behaviours within subjects is 0.52 and 0.26, respectively. This justifies the importance to examine the trajectories of externalising and internalising behaviour problems within subjects.

Latent growth curve analyses by gender

In the sample, 51.5 per cent of children ($N = 3,708$) were male and 49.5 per cent were female ($N = 3,640$). The latent growth curve model for male children indicated the estimated initial means of externalising and internalising behaviours, conditional on control variables, were 1.74 ($SE = 0.46$) and 2.04 ($SE = 0.30$). The estimated means of linear slope factors of externalising and internalising behaviours, conditional on all control variables and food insecurity patterns, were 0.14 ($SE = 0.09$) and 0.09 ($SE = 0.09$).

Differently from the hypothesis, most regression coefficients of food insecurity patterns on linear slope factors for male children (see first column of Table 3) were not statistically significant at the $p < 0.05$ level, indicating that male children living in food-insecure households did not have a different trajectories of children's behaviour problems from food-secure children. Two exceptions for internalising behaviour problems were regression coefficients of having food insecurity in Spring—third grade ($b = 0.040$, $p < 0.01$) and having food insecurity in both Spring—third and Spring—fifth grades ($b = 0.081$, $p < 0.001$). Male children living in households with these two patterns of food insecurity have a greater increase in the scale of internalising behaviours than their counterparts with different patterns of food insecurity. For externalising behaviours, two positive coefficients (food insecurity in Spring—third grade and food insecurity in Fall—kindergarten and Spring—third grade) were significant at the $p < 0.1$ level. These findings seem suggesting that male children were more sensitive to food insecurity in Spring—third grade.

Overall, the latent growth curve model for female children had similar results to those for male children (see the second column of Table 3). None of regression coefficients of food insecurity on the slope factors was significant at the $p < 0.05$ level. For internalising problems, three patterns of food insecurity (i.e. food-insecure in Spring—fifth grade, Spring—third and Spring—fifth grades, and persistent food-insecure) had a positive regression coefficient significant at the $p < 0.1$ level. For externalising problems, only the coefficient of food insecurity in Spring—third grade was positive and significant at the $p < 0.1$ level. The results may indicate that female children were more sensitive to food insecurity in Spring—third grade and Spring—fifth grade.

Finally, we plotted the estimated trajectories of behaviour problems for a typical male or female child using eight patterns of food insecurity (see Figure 2). A typical child was defined as one with median values on baseline behaviour problems and all control variables except for gender. Each

Table 3 Regression coefficients of food insecurity on slope factors of externalising and internalising behaviours by gender

Patterns of food insecurity	Male (<i>N</i> = 3,708)				Female (<i>N</i> = 3,640)			
	Externalising		Internalising		Externalising		Internalising	
	<i>B</i>	SE	<i>b</i>	SE	<i>b</i>	SE	<i>b</i>	SE
Pat.1: persistently food-secure (reference group)								
Pat.2: food-insecure in Spring—kindergarten	0.015	0.016	0.016	0.014	0.000	0.010	0.015	0.011
Pat.3: food-insecure in Spring—third grade	0.042 ^ψ	0.023	0.040**	0.015	0.053 ^ψ	0.031	0.011	0.014
Pat.4: food-insecure in Spring—fifth grade	-0.002	0.013	0.026	0.015	0.014	0.011	0.030 ^ψ	0.018
Pat.5: food-insecure in Spring—kindergarten and third grade	0.074 ^ψ	0.043	0.009	0.016	-0.006	0.020	0.015	0.015
Pat.6: food-insecure in Spring—kindergarten and fifth grade	0.047	0.037	-0.016	0.025	-0.017	0.020	0.008	0.017
Pat.7: food-insecure in Spring—third and fifth grades	0.031	0.035	0.081***	0.026	-0.017	0.021	0.048 ^ψ	0.024
Pat.8: persistently food-insecure	-0.005	0.029	-0.013	0.019	0.004	0.019	0.029 ^ψ	0.018

1. Pat. = long-term patterns of food insecurity. ^ψ $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

2. Overall, the model fit of the latent growth curve model for male children was adequate: $\chi^2(308, N = 3,708) = 622.26, p < 0.001$; comparative fit index (CFI) = 0.918; Tucker-Lewis Index (TLI) = 0.873; root-mean-square error of approximation (RMSEA) = 0.017, 90% CI = (0.015, 0.018); standardised root-mean-square residual = 0.018. The values of CFI and TLI were improved when serial dependence between children's behaviour problems was allowed (e.g. externalising behaviours at wave 1 and externalising behaviours at wave 2). However, the specification of serial dependence did not change regression coefficients of food-insecurity patterns significantly.

3. The model fit of the latent growth curve model for female children was adequate: $\chi^2(308, N = 3,640) = 551.31, p < 0.001$; comparative fit index (CFI) = 0.930; Tucker-Lewis Index (TLI) = 0.893; root-mean-square error of approximation (RMSEA) = 0.015, 90% CI = (0.013, 0.017); standardised root-mean-square residual = 0.017. The values of CFI and TLI were improved when serial dependence between children's behaviour problems was allowed (e.g. externalising behaviours at wave 1 and externalising behaviours at wave 2). However, the specification of serial dependence did not change regression coefficients of food insecurity patterns significantly.

pattern of food insecurity is indicated by the same type of line across each of the four parts of the figure. Patterns within each part were ranked by the level of predicted behaviour problems from the highest to the lowest. For example, a typical male child experiencing food insecurity in Spring—kindergarten and Spring—third grade had the highest level of externalising behaviour problems, while a typical female child with food insecurity in Spring—fifth grade had the highest level of externalising behaviour problems. If food insecurity affected children's behaviour problems in a similar way, it may be expected that there is a consistent association between the patterns of food insecurity and trajectories of children's behaviour problems across the four figures. However, a comparison of the ranking of prediction lines across these figures indicates this was not the case. These figures also do not indicate a

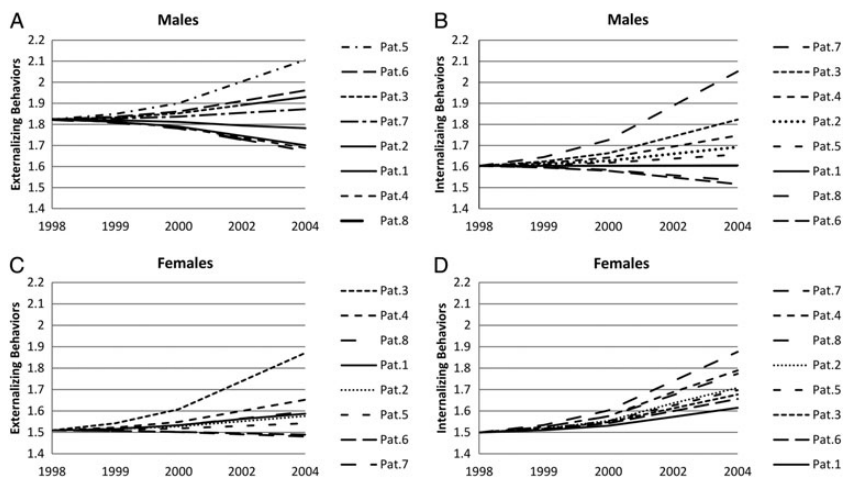


Figure 2 Predicted externalising and internalising behaviours by gender and long-term patterns of food insecurity. A typical child is defined as a child having median values on all control variables. Pat.1–Pat.8 correspond to eight long-term patterns of food insecurity listed in Tables 1 and 3: Pat.1, persistently food-secure; Pat.2, food-insecure in Spring—kindergarten; Pat.3, food-insecure in Spring—third grade; Pat.4, food-insecure in Spring—fifth grade; Pat.5, food-insecure in Spring—kindergarten and third grade; Pat.6, food-insecure in Spring—kindergarten and fifth grade; Pat.7, food-insecure in Spring—third and fifth grades; Pat.8, persistently food-insecure.

gradient relationship between developmental trajectories of behaviour problems and long-term patterns of food insecurity. As such, these results are consistent with the previously reported regression models.

Discussion

Our results showed, after controlling for an extensive array of confounds, that long-term patterns of food insecurity generally did not associate with developmental changes in children's behaviour problems. If food insecurity does have long-term impacts on children's behaviour problems, one would expect that it is likely to affect trajectories of children's behaviour problems as well. However, this hypothesis was not supported by the results in the study. One possible explanation could be that the impact of food insecurity on behaviour problems was relatively short-term, which might be overwhelmed by an estimate of average change rate indicated by the slope factor. Nonetheless, after adjusting for extensive covariates, food-insecure children seem not have statistically different development of behaviour problems from food-secure children.

Another possible explanation is that the impacts of food insecurity are more likely to interact with certain developmental stages (e.g. adolescence) and may show up more strongly at those stages. For example, the results

suggest children in the third and fifth grades might be more sensitive to food insecurity. Previous research has discussed the potential interaction between food insecurity and child's age. Focusing on preschool children, one study indicated a strong association between food insecurity and child development at age five (Zilanawala and Pilkauskas, 2012). Another paper based on the ECLS-K also suggested that the third grade was a stage more sensitive to food insecurity (Howard, 2011b). In addition, the findings of the current study may be explained by indirect effects. Food insecurity may operate as a distal factor through other proximal variables such as maternal stress or general care for children.

Despite the assets of the present study, several limitations should be noted. First, although it may help to shed light on estimating the impacts of food insecurity on children's behaviour problems, the study cannot test the causal relationship between food insecurity and behaviour problems. Second, similarly to other nationally representative longitudinal studies, the ECLS-K study also has issues of missing values and sample attrition. Third, while providing the aggregated scale values of externalising and internalising behaviours reported by teachers, the public-use files of the ECLS-K do not contain data on each survey item included in these scales. The study thus is not able to present distributions of these items within the externalising or internalising scale. Another limitation is that food insecurity was only included in three of five interviews. In addition, less than 20 per cent of households experienced food insecurity in the sample, and the classification of long-term food insecurity patterns may reduce the power of analyses.

Conclusion

There are several interrelated clinical and policy implications that can be derived from this study. First, the study focuses on the long-term trajectories of externalising and internalising behaviour problems in children from kindergarten to fifth grade. As shown in Table 2, overall, the mean scores of behaviour problems remain at the similar level over time. It is important for social work practitioners working in different contexts (e.g. families, schools and communities) to prevent or intervene children behaviour problems in early childhood. Low-level behaviour problems in early childhood are likely to affect the trajectories of behaviour problems subsequently. This is particularly important because challenging behaviour has severe repercussions for academic achievement and other life outcomes in later life stages (e.g. Battin-Pearson *et al.*, 2000; Breslau *et al.*, 2009).

Second, access to adequate and nutritious food is critical for normal physical growth and development. Despite several mechanisms being proffered by which food insecurity increases externalising and internalising behaviours (Rose-Jacobs *et al.*, 2008), the causal relationship is still not fully resolved. Consistently with the previous research (Howard, 2011a, 2011b; Jyoti *et al.*,

2005; Ryu, 2012), the findings of the study suggest that the impacts of food insecurity on children's behaviour problems may be transient. This knowledge can be useful for clinical practices to identify certain groups of children at risk of increased challenging behaviours. For example, the research on household food insecurity shows that a proportion of middle-income families may fall into food insecurity due to negative income shocks caused by unemployment, disability and other health conditions (Coleman-Jensen *et al.*, 2012). Potential indicators of the onset of food insecurity, such as starting receiving free or reduced-price lunch from school lunch programmes, could be used to monitor or explain children's increased behaviour problems.

In addition, the study suggests that children in certain developmental stages (e.g. adolescence) may be more sensitive to the influences of food insecurity than those in other stages. Thus, clinical practices that address food insecurity may beneficially impact problem behaviours evinced in such developmental stages. Future research should delineate the dynamic interactions between household economic hardship and child development as well. Although food insecurity is a serious problem that policy should address, promoting food security is only one means to prevent childhood behaviour problems may not be sufficient. To prevent behaviour problems, clinicians should address food insecurity and also apply behavioural interventions drawn from the prevention of behavioural problems, especially early conduct problems (Comer *et al.*, 2013; Huang *et al.*, 2010).

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