

Social Science & Medicine 61 (2005) 1971-1982



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Food insufficiency and women's mental health: Findings from a 3-year panel of welfare recipients

Colleen M. Heflin^{a,*}, Kristine Siefert^b, David R. Williams^c

^aMartin School of Public Policy, University of Kentucky, 429 POT, Lexington, KY 40503, USA

^bNIMH Research Center on Poverty, Risk, and Mental Health, University of Michigan, 1080 S. University, Ann Arbor,

MI 48109-1106, USA

^cInstitute for Social Research, University of Michigan, 426 Thompson Street, Rm. 2230, Ann Arbor, MI 48106-1248, USA

Available online 31 May 2005

Abstract

Household food insufficiency is a significant problem in the United States, and has been associated with poor outcomes on mental health indicators among low-income women. However, it is difficult to disentangle the mental health consequences of household food insufficiency from poverty and other shared risk factors. Drawing on theories of the social production of health and disease, research evidence linking food insufficiency with poor mental health, and high rates of food insufficiency among welfare recipients, we examined whether a change in household food insufficiency is associated with a change in women's self-reported mental health in a sample of current and recent welfare recipients over a 3-year period of time, controlling for common risk factors. Data were obtained from a prospective survey of women who were welfare recipients in an urban Michigan county in February 1997 (n = 753). We estimated fixed effect models for changes in mental health status that make use of information on household food insufficiency gathered in the fall of 1997, 1998, and 1999. The relationship between household food insufficiency and respondents' meeting the diagnostic screening criteria for major depression remained highly significant even when controlling for factors known to confer increased risk of depression and time invariant unobserved heterogeneity. These findings add to growing evidence that household food insufficiency has potentially serious consequences for low-income women's mental health. If confirmed by further research, they suggest that the public health burden of depression in welfare recipients and other low-income women could be reduced by policy-level interventions to reduce their exposure to household food insufficiency. © 2005 Elsevier Ltd. All rights reserved.

Keywords: Food insufficiency; Food security; Low-income women; Mental health; Depression; USA

Introduction

The Personal Responsibility and Work Opportunity Reconciliation Act of 1996 eliminated entitlements to

*Corresponding author. Tel.: +18592578608; fax: +18593231923. cash benefits for low-income families with children, imposed work requirements and a 5-year lifetime limit on benefits, and separated cash assistance from food assistance. The maximum Food Stamp benefit was reduced, and TANF recipients who leave welfare may lose Food Stamp benefits altogether. The number of food stamp recipients fell from a historic high of 27.5 million in 1994 to 17.4 million by the end of 1999; welfare caseloads fell by 50% over this same time period (US Council of Economic Advisors, 1999). Since then,

E-mail addresses: cmh@uky.edu (C.M. Heflin), ksiefert@umich.edu (K. Siefert), wildavid@umich.edu (D.R. Williams).

^{0277-9536/\$ -} see front matter © 2005 Elsevier Ltd. All rights reserved. doi:10.1016/j.socscimed.2005.04.014

food stamp caseloads have rebounded to 22 million in July 2003, the most recent month available (USDA, 2003). With the movement of millions of families from welfare to work, increased food insecurity and hunger and their effects on the well-being of current and recent welfare recipients are a rising concern (Mills, Dorai-Raj, Peterson, & Alwang, 2001; Lerman & Wiseman, 2002).

High rates of food insecurity, food insufficiency, and hunger¹ are a significant problem in the United States (Alaimo, Briefel, Frongillo, & Olson, 1998). In 2000, 10.5% of US households-over 33 million people-were estimated to live in food insecure households, meaning that at some time during the previous year, they were unable to acquire or were uncertain of having enough food to meet basic needs due to inadequate household resources (Nord, Kabbani, Tiehen, & Andrews, 2002). Among these, 3.3 million households were food insufficient, meaning that they were food insecure to the extent that one or more household members went hungry at least some time during the year because they could not afford food (Nord et al., 2002). Food insecurity was substantially higher among households with incomes below the poverty line and households with children headed by a single woman, who had rates of 36.8% and 31.0%, respectively. Among 753 women sampled from the welfare rolls in an urban county in Michigan and surveyed a year later, 25% reported that their household sometimes or often did not have enough to eat (Corcoran, Heflin, & Siefert, 1999). Food insufficiency was higher among those who reported health and mental health problems.

Persistently high rates of household food insufficiency pose a significant problem, potentially affecting both physical and psychological well-being (Olson, 1999; Campbell, 1991; Dixon et al., 2001). However, it is difficult to disentangle the health and psychosocial consequences of food scarcity from those of poverty and other common risk factors (Olson, 1999; Campbell, 1991). Building on previous work, the present study investigates the effects of food insufficiency on current and recent welfare recipients' mental health over a 3-year time period. Using a fixed effects model and controlling for potentially common risk factors, we examine the effects of changes in food insufficiency on changes in two mental health indicators: respondents' meeting the diagnostic screening criteria for major depressive disorder and their sense of mastery. We hypothesize that household food insufficiency will be associated with higher risk of depression and lower levels of mastery, while controlling for measured factors known to affect women's mental health and well-being and time invariant unobserved heterogeneity.

Background: food insufficiency

Rates of food insufficiency vary considerably by race, gender, and household income. The Third National Health and Nutrition Examination Survey (NHANES III) found rates of food insufficiency to be 11.8% among low-income whites, 13.5% among low-income non-Hispanic Blacks, and 24.8% among low-income Mexican Americans (Alaimo et al., 1998). Low-middleincome single female-headed families with children were 5.5 times more likely than other family types to be food insufficient. More recently, the USDA found that in 2000, the prevalence of food insecurity with hunger (one or more household members were hungry, at least some time during the year, because they could not afford enough food) was 3.1%, or 3.3 million households (Nord et al., 2002). Households with annual income below 185% of the poverty line were seven times more likely to report hunger than those with higher income (Nord et al., 2002). Food insecurity with hunger was 12.7% among households with incomes below the official poverty line, 9.0% among families headed by a single woman, 6.5% among Black households, and 4.8% among Hispanic households.

Importantly, researchers have begun to establish a relationship between an inadequate household food supply and lower energy and nutrient intakes among women. Rose and Oliveira (1997) analyzed the diets of adult women in the 1989-1991 Continuing Survey of Food Intake by Individuals and reported that household food insufficiency was significantly associated with low energy and nutrient intakes. This finding, based on a single 24-h recall, does not necessarily imply dietary inadequacy, but it supports the use of self-reported hunger measures as valid indicators of increased risk of dietary inadequacy (Sidel, 1997). Additional evidence comes from a study of 145 women in families receiving emergency food assistance in Toronto; those reporting hunger in their household during the past month reported systematically lower intakes of energy and nutrients, controlling for a broad range of potential

¹Survey researchers use various terms to describe food scarcity and deprivation. "Food insecurity" refers to the limited or uncertain availability of food, while "food insufficiency" refers to restricted household food stores or insufficient food intake (Scott & Wehler, 1998). "Hunger" refers narrowly to insufficient food intake. Food insecurity differs conceptually from food insufficiency and hunger, which can be considered roughly equivalent (Rose, 1999). The distinction between food insufficiency and food insecurity or hunger can best be understood from a temporal frame of reference: food insecurity can be experienced prior to the onset of food insufficiency or hunger, and may or may not result in food insufficiency or hunger (Scott & Wehler, 1998). Food insecurity with hunger, a measure recently adopted by the United States Department of Agriculture, is conceptually comparable to food insufficiency (Dixon, Winkleby, & Radimer, 2001).

behavioral, economic, and sociocultural factors that might influence diet (Tarasuk & Beaton, 1999).

A recent study by Dixon et al. (2001) found that adults in food insufficient households were more likely to have potentially health-compromising diets than adults from food sufficient families, and also had lower serum concentrations of essential nutrients, elevating the risk of a number of major chronic diseases. These findings should be interpreted cautiously due to small sample size and other methodological limitations, but the observed association between systematically low reported nutrient intakes and food insecurity with moderate or severe hunger, independent of other potential influences on diet, supports concerns that women in food insufficient households may be at higher risk of nutrient shortfalls that can ultimately affect their health and well-being.

Poor mental health among the welfare-to-work population

Fueled by increasing concern regarding welfare recipients' ability to meet federally mandated work requirements in the post-welfare reform era, a growing body of literature documents a high prevalence of mental health problems and other barriers to employment among the welfare population. These barriers include depression, anxiety, and substance abuse disorders, physical health problems, and domestic violence (Olson & Pavetti, 1996; Kalil et al., 1998; Zedlowski & Loprest, 1999; Danziger et al., 2000; Polit, London, & Martinez, 2001). Given the growing emphasis of state welfare programs on rapid labor market entry, mental health disorders, which are strongly associated with reduced employment and earnings, are of particular concern (Marcotte & Wilcox-Gok, 2001).

Depression in particular has received considerable attention because it is a disabling and costly illness that is highly prevalent among welfare recipients. High rates of major depression among women receiving welfare have been documented (Jayakody, Danziger, & Pollack, 2000; Siefert, Bowman, Heflin, Danziger, & Williams, 2000; Lennon, 2001); a recent review found that 44.5% reported depressive symptoms and a median of 22% met the diagnostic criteria for major depression (Lennon, Blome, & English, 2002). Depression is associated with substantial impairment in vocational and social functioning (Wells, Stewart, & Hays, 1989; Murray & Lopez, 1996; Kessler & Frank, 1997; Dewa & Lin, 2000), and is of concern to policy-makers trying to move women from welfare-to-work because it is associated with lower levels of work and increased welfare receipt (Lehrer, Crittenden, & Norr, 2005; Horowitz & Kerker, 2001; Danziger et al., 2000). In addition, welfare recipients must contend with the demands of parenting while trying to meet federally mandated work requirements, and maternal depression has been associated with numerous adverse health and developmental consequences for children (Field, 1992; Leadbeater & Bishop, 1994; Heneghan, Johnson Silver, Westbrook, Stein, & Bauman, 1998).

Recent research on the causes and course of depression indicates that social and environmental factors, that is, stressful life events and conditions, confer increased risk for its onset and recurrence (Checkley, 1996; McEwen, 1998; Frank & Thase, 1999). Depression is associated with hypothalamic dysfunction, specifically hypercortisolism, and the effects of social and environmental risk factors probably operate through the highly stress-responsive hypothalamic-pituitary-adrenocortical (HPA) axis (Gold, Goodwin, & Chrousos, 1988; Checkley, 1992; Rubin, 1989; McEwen, 1998). Up to two-thirds of those who experience one episode of major depression suffer a recurrence, and multiple episodes increase both risk of recurrence and length and severity of subsequent episodes (Wells, Sturm, Sherbourne, & Meredith, 1996; Frank & Thase, 1999). Thus, it is of great importance to identify modifiable risk factors related to a change in depression status.

Research has also demonstrated that women receiving welfare have lower levels of a sense of mastery than similar women not on welfare (Petterson & Friel, 2001; Kunz & Kalil, 1999). Mastery, a psychological construct that captures perceptions about oneself as a causal agent in one's environment, is widely considered a fundamental characteristic that affects individuals' ability to influence their environment and control important life outcomes (Rothbaum, Weisz, & Snyder, 1982). It is the belief that one can hold one's own life and solve one's problems (Lombardi & Ulbrich, 1997). High levels of mastery and control have been inversely related to socioeconomic status (Mirowsky & Ross, 1986), and positively related to physical and mental health (Rodin, 1986; Karasek, Tehorell, Schwartz, Peiper, & Alfredson, 1982; Petterson & Friel, 2001; Danziger, Carlson, & Henley, 2001).

Food insufficiency and poor mental health

Although the possible bi-directionality in the relationship between household food insufficiency and mental health must be considered, it is quite plausible that household food insufficiency could adversely affect the mental health of welfare recipients. First, household food insufficiency may be subjectively experienced as stressful, and its presence or persistence could initiate or maintain feelings of self-blame and the perception that one is not efficacious. An individual's sense of mastery is largely a consequence of experiencing oneself as efficacious (Gecas & Schwalbe, 1983), and exposure to stressful life experiences can erode one's sense of mastery (Kraus & Tran, 1989). Likewise, the association between cumulative or persistent stressful life events or conditions and onset or chronicity of depression, particularly among single mothers with low self-esteem and lack of support, is well documented (Brown & Harris, 1978; Costello, 1982; Brown & Moran, 1997).

Second, food insufficiency could impair mental health through the direct effect of nutritional shortfalls on psychological functioning and behavior. Even the early stages of nutrient deficiency can adversely affect behavior and mental performance; in an experimental study of 1081 young men in good health, reduced vitamin intake over a 2-month period was associated with negative changes in psychological disposition and functioning (Heseker, Kubler, Pudel, & Westenhoffer, 1992). Inadequate vitamin intake was associated with increased irritability, nervousness, depression, feelings of fear and decreased well-being, memory and reaction performance. Importantly, several of these effects were reversed by providing vitamin supplements. More recent studies have focused on the role of vitamin B₁₂ and folate deficiency on depression and dementia (Tiemeier et al., 2002; Alpert, Mischoulon, Nirenberg, & Fava, 2000; Reynolds, 2002).

Drawing on theories of the social production of health and disease, which posit that an individual's social and economic positioning determines their exposure to health-damaging risk factors (Krieger, Rowley, Herman, Avery, & Phillips, 1993; Krieger & Zierler, 1995; Link & Phelan, 1995; Williams, Yu, Jackson, & Anderson, 1997; Denton & Walters, 1999); research evidence linking food insufficiency with poor health; and high rates of food insufficiency among welfare recipients, Siefert, Heflin, Corcoran, and Williams (2001) hypothesized that household food insufficiency could contribute to poor health and mental health in this population. In a cross-sectional analysis that controlled for other factors known to influence women's health and well-being, food insufficiency remained a significant predictor of self-rated health, limitations in physical functioning, and major depression. However, a limitation of this study was its cross-sectional design.

The same authors then analyzed the relationship between household food insufficiency and women's health in the same sample at two points in time: fall 1997 and approximately 1 year later (Siefert, Heflin, Corcoran, & Williams, 2004). Controlling for common risk factors, women who reported food insufficiency at both times were significantly less likely to report a high sense of mastery over their lives. Food insufficiency at wave 2 only was significantly associated with meeting the diagnostic screening criteria for recent major depression, as well as with a lower sense of mastery. These findings have potentially important implications; unlike household food insufficiency, many risk factors for depression, such as low socioeconomic status, gender, or genetic disposition, are global or not readily modified (National Advisory Mental Health Council Work Group on Mental Disorders Prevention Research, 1998). If food insufficiency is a contributing or causal

factor in major depression, preventing or ameliorating it might reduce the risk of onset or recurrence of this costly and disabling illness. However, these findings may be biased due to the presence of unobserved heterogeneity and therefore, are not conclusive. The present study uses a fixed effects model to address this limitation by controlling for unmeasured time invariant factors.

Methods

Study design and sample

Details of the data set and survey methods are described elsewhere (Danziger et al., 2000). Briefly, we analyzed data from the first three waves of the Women's Employment Study, a panel survey of barriers to employment among 753 mothers who were receiving cash assistance in an urban Michigan county in February 1997. Trained staff of the Survey Research Center of the Institute for Social Research of the University of Michigan conducted face-to-face, inhome, structured interviews between August and December 1997, August and December 1998, and November 1999 and March 2000. The first two interviews lasted approximately 1 h; the third, about 90 min. Women were eligible if they resided in the study county, received cash assistance in February 1997, were single and a US citizen between the ages of 18 and 54, and claimed a racial identity of white or African-American (there were too few other minority residents of this county to conduct reliable analyses).

A simple random sampling scheme was used. Cases were systematically selected with equal probability from an ordered list of eligible single mothers. To derive a representative sample of the metropolitan area and the study population, cases were proportionately selected by zip code, race (African American or non-Hispanic white), and age. The response rate was 86.2% at wave one; 92% at the second wave; and 91% at the third wave. In the first wave about half the respondents were African-American, 27.0% were aged 35 years or older, 36.8% had three or more children, and 31.2% had not completed high school. Given the very low attrition rate between each of the waves and subsequent analyses indicating that surveyed respondents do not differ from attriters on characteristics such as race, food insufficiency, and the two outcomes examined here, the risk of attrition bias is quite low. Therefore, the data were not weighted. Table 1 presents descriptive statistics from the pooled sample for variables used in the analysis.

Variables assessed and definitions

Food insufficiency was defined narrowly as restricted household food stores or too little food intake among

 Table 1

 Descriptive statistics (standard deviations)

Variable	Mean	Total number of observations		
Food insufficiency	0.24 (0.42)	2018		
Depression	0.20 (0.40)	2016		
Mastery	22.05 (3.35)	2010		
Married/cohabiting	0.31 (0.46)	2017		
Number of other adults	1.31 (0.70)	2017		
in the household				
Number of children in	2.34 (1.38)	2018		
the household	· /			
Net monthly household income	1460.36 (904.38)	2018		
Neighborhood hazards	16.06 (4.49)	1960		
Stressful life circumstances	2.15 (1.70)	2015		
Domestic violence	0.14 (0.35)	2017		
Sex discrimination	0.37 (0.82)	1984		
Race discrimination	0.31 (0.71)	1987		

either adults or children in the household (Scott & Wehler, 1998) and was operationalized using the question: "Which of the following describes the amount of food your household has to eat—enough to eat, sometimes not enough to eat, or often not enough to eat?" This single-item measure is widely accepted as a valid measure of food insufficiency (Rose and Oliveira, 1997; Alaimo et al., 1998; Rose, 1999). Following the convention that has been adopted in related research (Alaimo et al., 1998), we coded respondents as food insufficient who answer "sometimes" or "often."

We operationalized our dependent variable, women's mental health, by using measures of both negative and positive aspects of mental health and psychological functioning: major depression and sense of mastery. Major depression was assessed using the 12-month screening version of the World Health Organization's (WHO) Composite International Diagnostic Interview (CIDI) (WHO, 1990; Kessler, Andrews, Mroczek, Ustun, & Wittchen, 1998). WHO field trials and other methodological studies (Wittchen, 1994; Blazer, Kessler, McGonagle, & Swartz, 1994) have documented acceptable test-retest reliability and clinical validity of the CIDI diagnoses. We measured mastery, which refers to the degree to which individuals perceive themselves to be in control of their own lives, by using the seven-item Pearlin Mastery Scale (Pearlin, Lieberman, Menaghan, & Mulan, 1981), a widely used measure of this construct with a range of 0-28.

Our independent variables include sociodemographic and personal characteristics known to be associated with women's mental health, including number of children in the household, marital status, the number of other adults in the household, and annual gross household income. A woman is coded as married if she is married or living with her partner.

In keeping with our theoretical perspective on the social production of disease, we examined a broad array of social and environmental risk factors related to race, gender, and social class and known to be associated with increased risk of mental health problems among women (Adler, Boyce, Chesney, Folkman, & Syme, 1993; Alaimo et al., 1998; Bassuk et al., 1996; Brown & Moran, 1997; Corcoran et al., 1999; Denton & Walters, 1999; Kendall, Olson, & Frongillo, 1996; Link & Phelan, 1995; Rose, 1999; Siefert et al., 2000, 2001). These factors include poverty-related stressful life circumstances, such as homelessness or utility shutoffs, and living in a hazardous neighborhood. We also measured domestic violence, which has been shown to adversely affect physical and mental health among women and has also been associated with food insufficiency (Corcoran et al., 1999; Siefert et al., 2001; Tolman & Rosen, 1998).

We also controlled for self-reported experiences of *discrimination* based on race or gender. Perceived discrimination has been associated with poor physical and mental health (Kessler, Mickelson, & Williams, 1999; Krieger et al., 1993; Williams, Neighbors, & Jackson, 2003), and women of color are disproportionately represented among the food insufficient (Bickel, Carlson, & Nord, 1999).

Stressful life circumstances were defined as positive responses to an 11-item measure which we adapted for this study from the Difficult Life Circumstances scale, which was developed by Booth, Mitchell, Barnard, and Spieker (1989) and adapted for use in the New Chance study of young mothers in poverty by Quint, Bos, and Polit (1997). Items measure ongoing or habitual stressors that are often a feature of living in poor communities, such as utility shutoff, eviction, and homelessness. *Neighborhood hazards* were measured using an 11-item scale developed by Furstenberg, Cook, Eccles, Elser, and Sameroff (1998), which asks respondents to rate the presence of such problems as muggings, gangs, vandalism, and lack of police protection in their neighborhood.

Domestic violence was measured using items drawn from the Conflict Tactics Scale (Straus & Gelles, 1986), a widely used measure of family violence. In the present study, respondents were defined as having experienced domestic violence if they reported experiencing any of the six indicators of severe physical violence (hit with a fist, hit with an object, beaten, choked, threatened or assaulted with a weapon, or forced into sexual activity) by a partner within the past year.

Questions about perceived discrimination based on race or gender were adapted from items used in surveys by Bobo (1995) and Williams et al. (1997). *Discrimination based on race* was defined as the number of positive responses to a series of five questions that asked about unfair treatment while seeking employment or in the workplace, including whether respondents thought they had ever been refused a job, fired, or not promoted because of their race. *Discrimination based on gender* was defined the number of positive responses to a series of six questions which asked about unfair treatment while seeking employment or in the workplace, including whether respondents thought they had ever been refused a job, fired, or not promoted because of their sex, whether they had been sexually harassed, and if their supervisor made insulting remarks about women.

Data analysis

We estimate fixed effect models for the change in mental health status. Changes in food insufficiency are the main independent variables. This method has one principal advantage. By controlling for all individualspecific factors that are constant over time, it eliminates certain kinds of omitted variable biases in crosssectional research (Powers & Xie, 2000). With ordinary least squares regression, a component of the error term may be correlated with other independent variables in the model. Suppose that individual temperament affects reports of both mental health and food insufficiency. It could be, for example, that women with outlooks that are more negative than average are also more likely to rate themselves as sometimes not having enough food to eat. In that case, the effect of food insufficiency on depression status observed by Siefert et al. (2004) may be biased due to personality characteristics not measured directly. Our analysis controls for unmeasured individual traits that affect both mental health and food insufficiency, as long as their effect does not change over time.

The specific fixed effect model used in this paper is shown in Eq. (1). Each variable in the equation is averaged over all assessed time points for a specific woman. This average value is then subtracted from the value at a specific time point for that woman. As a result, the time invariant measured and unmeasured characteristics for a specific woman, such as race, drop out of the model

$$Y_{it} - Y_{i.} = \alpha_{it} - \alpha_{i.} + \beta_1 (\text{food_insf}_{it} - \text{food_insf}_{i.}) + \gamma_1 (\text{controls}_{it} - \text{controls}_{i.}) + \varepsilon_{it} - \varepsilon_{i.}$$
(1)

Hausman tests² were performed to test for correlation of the omitted variables with other regressors in the equation and were all highly statistically significant (p < 0.001). Since depression is a dichotomous outcome, we use a conditional fixed effect logistic regression model; mastery is modeled using linear fixed effect models.

Using fixed effect models has one main conceptual disadvantage that renders it an inappropriate method for some questions in that time invariant measured characteristics are dropped from the model. This means that background characteristics such as race are not included in the analysis. Additionally, the interpretation of the relationship between the prime variable of interest, in this case food insufficiency, and the outcome (depression or mastery) is that of the change in X (food insufficiency) that is associated with the change in Y(depression or mastery). Consequently, this analysis does not yield any new information about respondents who are persistently depressed nor can it speak to the cumulative effects on mental health of persistent food insufficiency.³ This paper examines whether a change in food insufficiency is associated with a change in mental health.

We estimate three nested models to examine the independent effects of three sets of factors on our two dependent variables. In Model 1, we begin by showing the bivariate relationships between food insufficiency and each of the dependent variables. In Model 2, we control for the household composition and household income. In Model 3, we control for the social and environmental risk factors described above.

Results

Table 1 presents descriptive statistics for variables used in the analysis. Approximately one-quarter of the observations meet the criteria for food insufficiency. One in five meet the criteria for major depression and the mean mastery score is 22. The average household consists of 1.31 adults and 2.34 children. Almost one-third of the observations report living with a husband or opposite-sex domestic partner. Mean net monthly household income is \$1460. The average score on the neighborhood hazards index is 16.06; the mean number of stressful life circumstances reported is 2.15. Fourteen percent of respondents report experiencing domestic violence. The average number of experiences of sex discrimination is 0.37 and the average for racial discrimination is 0.31.

Table 2 illustrates the change in food insufficiency, depression and mastery over the three waves. As the first row of Table 2 illustrates, the prevalence of food insufficiency is roughly similar across the three waves; however, it is not the same group reporting food insufficiency at each wave. Instead, 23% report being food insufficient at just one wave, 13% at two waves.

²If the Hausman tests were not significant, this would have indicated that the omitted variables were randomly distributed with respect to the error term and that random effect, and not fixed effect, models were appropriate.

³These questions are examined elsewhere.

0.1.2	
ve Only 2 waves All 3 wa	ves
13.3 7.6	
10.0 5.4	
12.4 0.5	
1	re Only 2 waves All 3 wave 13.3 7.6 10.0 5.4 12.4 0.5

Table 2 Prevalence of food insufficiency, depression and low mastery at waves 1-3

Note: Sample includes 632 respondents present at all three waves.

^a"Low Mastery" is a dichotomous version of the Pearlin Mastery Scale in which score less than 20 indicates low levels of mastery. ^b"Mean Mastery" indicates the mean score on the Pearlin Mastery Scale (0–28).

Eight percent report persistent food insufficiency and 57% report persistent food sufficiency at each interview point. Results differ somewhat for depression. The prevalence of depression drops from wave 1 to wave 2, from 26% to 17%, and remains at 18% for wave 3. The dynamics of depression mirror those of food insufficiency with 59.6% never meeting the criteria for depression, 5.4% meeting the criteria at each wave, and 25.1% and 10% meeting the criteria at one and two waves, respectively. The percentage of women reporting low mastery fluctuates more than food insufficiency and depression with rates increasing substantially in the third wave. Additionally, the proportion of women reporting low mastery for at least one wave is comparable to those never reporting low mastery. Overall, there is a substantial degree of change in the food insufficiency status and the proportion of women meeting the criteria for major depression and the mastery.

Tables 3 and 4 present fixed effect results for the two dependent variables, depression and mastery. Model 1 of Table 3 presents results predicting a change in major depression status controlling for a change in food insufficiency. Here, a change in food insufficiency status is highly positively associated with a change in major depression status. After controlling for changes in household composition in Model 2, the strong association between food insufficiency and depression remains. Additionally, consistent with the literature on marriage (Waite, 1995), a change in marital or cohabitation status is negatively associated with a change in depression. When social-environmental stressors are added in Model 3, a change in food insufficiency status continues to be positively associated with a change in depression status. Additionally, there is a marginal positive association between a change in reports of racial discrimination and a change in depression status. Most prior research on discrimination and mental health is cross-sectional; this finding is consistent with the hypothesis that discrimination can lead to adverse changes in mental health.

In Table 4 we present results predicting sense of mastery. In contrast to prior research, the results here do

not support our hypothesis as we find no relationship between a change in food insufficiency status and a change in mastery in Models 1 through 3. In Model 2, we do find that an increase in net monthly household income is associated with an increase in mastery, although the size of the coefficient indicates the substantive association is not large. Among other social and environmental stressors entered in Model 3, we find that a change in domestic violence status is associated with a significant drop in mastery.

Discussion

The findings of this study are consistent with growing evidence that food insufficiency is strongly associated with depression and may be a causal or contributing factor. Although the results of our analyses did not support the hypothesized relationship between food insufficiency and sense of mastery, the relationship between food insufficiency and respondents' meeting the diagnostic screening criteria for major depression remained highly significant even when controlling for factors known to confer increased risk of depression and time invariant unobserved heterogeneity. We are, of course, limited in drawing conclusions between the relationship between household food insufficiency and depression by our reliance on self-reported data. Furthermore, we cannot rule out the possibility that the causal relationship between food insufficiency and depression is simultaneous or possibly reversed, with depression leading to food insufficiency.

Nevertheless, although a detailed discussion of the mechanisms whereby food insufficiency might affect the onset, maintenance, or recurrence of major depression are beyond the scope of this paper, household food insufficiency is associated with lower energy and nutrient intakes (Christofar & Basiotis, 1992; Kendall et al., 1996; Rose & Oliveira, 1997; Dixon et al., 2001). As noted, a recent analysis of NHANES III data found that adults in food insufficient households were more likely to have diets that may compromise their health and

Table 3

Conditional fixed-effect logistic regression results predicting a change in depression status (standard errors in parentheses)

	Model 1		Model 2		Model 3	
Food insufficiency	0.84	(0.23)**	0.83	(0.23)**	0.75	(0.24)**
Married/cohabiting			-0.86	(0.30)**	-0.84	(0.31)*
Number of other adults in the household			-0.11	(0.17)	-0.13	(0.18)
Number of children in the household			-0.03	(0.14)	-0.03	(0.14)
Net monthly household income			-0.00001	0.00011	0.00002	0.00011
Neighborhood hazards					0.03	(0.03)
Stressful life circumstances					0.10	(0.06)
Domestic violence					0.02	(0.25)
Sex discrimination					-0.02	(0.11)
Race discrimination					0.27	(0.14) +
Number of observations	630		630		630	
χ^2	14.21		24.32		33.43	
$Prob > \chi^2$	0.0002		0.0002		0.0002	

+ Indicates p < 0.10, * indicates p < 0.05, ** indicates p < 0.01.

Table 4

Fixed-effect regression results predicting a change in mastery (standard errors in parentheses)

	Model 1		Model 2		Model 3	
Food insufficiency	-0.30	(0.20)	-0.28	(0.20)	-0.23	(0.20)
Married/cohabiting			0.04	(0.24)	-0.01	(0.24)
Number of other adults in the household			0.00	(0.14)	0.00	(0.14)
Number of children in the household			0.07	(0.10)	0.06	(0.10)
Net monthly household income			0.00026	0.00010**	0.00024	0.00010**
Neighborhood hazards					-0.01	(0.03)
Stressful life circumstances					-0.08	(0.06)
Domestic violence					-0.55	(0.23)*
Sex discrimination					0.10	(0.11)
Race discrimination					-0.12	(0.12)
Number of observations	1917		1917		1917	
Overall R^2	0.0328		0.0274		0.0523	

+ indicates p < 0.10, * indicates p < 0.05, ** indicates p < 0.01.

lower serum concentrations of several critical nutrients compared with adults from food insufficient families (Dixon et al., 2001). As these authors note, low intakes and concentrations of such nutrients may compromise immune function, and increase the risk of major chronic diseases, including cardiovascular disease, certain types of cancer, osteoporosis, macular degeneration, and cataracts. To our knowledge, studies of the relationship between household food insufficiency, serum concentrations of nutrients, and major depression have not been conducted; this warrants further investigation.

In addition to the possibility that household food insufficiency could directly affect the onset or recurrence of major depression through nutritional deprivation, the known depressogenic effects of stressful life events and conditions must also be considered as a potential pathway to depression among women in food insecure households. As noted, the HPA axis is highly responsive to stress, and research on the effects of exposure to stressful life events and chronically stressful conditions shows that they are associated with sustained circulating levels of cortisol, which alters mood, cognition, and behavior (McEwen, 1998; Rubin, 1989; Checkley, 1992). Anticipatory worry about the adequacy of one's household's food supply and the actual experience of not having sufficient food in the household are stressful experiences that could plausibly contribute to dysregulation of the HPA axis (McEwen, 1998).

Household food insufficiency is a specific and modifiable risk factor (Siefert et al., 2000). If confirmed by further research, the findings of this study have practical implications. Although important gains have been made in developing effective interventions for major depression (Katon, Von Korff, & Lin, 1995; Schulberg, Katon, Simon, & Rush, 1998; Wells et al., 1996), the recurrence rate is high even with treatment (Kupfer, 1993; Lin, Katon, & Von Korff, 1998). Recommendations for reducing risk of relapse-which, as noted, increases the likelihood of chronicity and disability-include educating individuals to recognize early warning symptoms, encouraging specific behaviors to improve medication adherence, and providing psychoeducational techniques to improve adaptation to acute and chronic stressors (Lin et al., 1998). Our findings suggest that relapse prevention might also be improved by policy-level interventions to reduce exposure to household food insufficiency. Such interventions might also be costeffective compared with maintenance pharmacotherapy, which can be associated with undesirable side effects (Schulberg et al., 1998; Lin et al., 1998). Moreover, hunger has been linked with psychosocial and academic problems in poor children, and may contribute to later aggressive behavior and school drop-out in adolescence (Murphy et al., 1998). Reducing maternal exposure to household food insufficiency could also potentially improve child mental health outcomes in this high-risk population.

Finally, our findings have implications for the development of interventions to prevent the onset of depression. To our knowledge, there have been no programs aimed at preventing depression among highrisk mothers by reducing their exposure to household food insufficiency. The National Advisory Mental Health Council Work Group on Mental Disorders Prevention Research (1998) found that preventive intervention strategies have "primarily focused on changing individual-level processes, giving less attention to change in other, larger units such as family, school, and community, and how these larger united factors interact with individual-level factors and with each other to lead to the development of mental disorders." If confirmed by further research, our findings suggest that interventions to prevent household food insufficiencyincluding interventions at the policy level-could help reduce the incidence as well as the prevalence of major depression in welfare recipients. It is our hope that the findings of this study will stimulate additional research in this important area.

Acknowledgements

Support for this study was provided by the Food Assistance and Nutrition Research Program of the United States Department of Agriculture's Economic Research Service; the Institute for Research on Poverty Small Grants Program, University of Wisconsin; National Institute of Mental Health Grant No. R24-MH51361, and the Charles Stewart Mott and Joyce Foundations.

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