The Modifying Effects of Food Stamp Program Participation on the Relation between Food Insecurity and Weight Change in Women\textsuperscript{1,2}

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ABSTRACT Food insecurity has been associated with overweight status in women. A number of hypotheses have been proposed to explain this association, some of which assume that household food insecurity is a cause of overweight. Similar to food insecurity, Food Stamp Program (FSP) participation has been associated with overweight status in women. One longitudinal study has also found a small effect of program participation on obesity status in women. Modeling FSP participation without accounting for the effect of need to participate in the program, as estimated by household food insecurity status, may lead to confounded findings. To estimate the direction and timing of the relation between food insecurity, this study reports on recently available longitudinal data from the Panel Study of Income Dynamics. The major finding of this paper is that persistent food insecurity was associated with a smaller weight change, controlling for other income and health-related risk factors for weight change. Among persistently food-insecure women, full participation in the FSP offset the weight change. There were no significant associations between change in food insecurity status and weight change in these data. J. Nutr. 136: 1091–1094, 2006.

KEY WORDS: \quad \textbullet \quad \text{food insecurity} \quad \textbullet \quad \text{weight change} \quad \textbullet \quad \text{Food Stamp Program} \quad \textbullet \quad \text{women} \quad \textbullet \quad \text{longitudinal}

Cross-sectional studies have found that food insecurity is associated with an increased risk of a woman being classified as overweight (1–5). National survey data indicate that women in households that are moderately food insecure are more likely to be overweight than women in food-secure households (1,2). In a smaller sample in upstate New York, women in households that were moderately food insecure had higher body mass index (BMI)\textsuperscript{1} than women in food-secure or severely food-insecure households (3). Whereas these reported associations between food insecurity do not provide evidence for causal inference, some have hypothesized that food insecurity causes obesity (2,6). Cross-sectional data are limited, however, and cannot reveal the timing and direction of the relation between food insecurity and weight change (7).

Two recent studies have found a relation between women's weight status and Food Stamp Program (FSP) participation. Townsend and colleagues reported that women who participated in the FSP had 38\% increased odds of being classified as overweight (BMI > 27.3 kg/m\textsuperscript{2}) after controlling for food insecurity status and other potential confounders (8). Likewise, Gibson found that women who participated in the FSP for 100\% of the time over a 5\-year period increased their probability of being classified as obese (BMI > 30 kg/m\textsuperscript{2}) by 4\% percentage points after controlling for income and other fixed effects (9). Each of these studies, however, had limitations in their conceptualization of the role of food assistance participation in subsequent weight gain.

In this study, we hypothesize that household food insecurity acts as a stressor in a woman's life and may lead to stress-induced weight change. FSP participation should ameliorate the stress of food insecurity and therefore may ameliorate the effects of food insecurity on weight change. We use longitudinal data to evaluate this hypothesis.

MATERIALS AND METHODS

Data. This study used data from the Panel Study of Income Dynamics (PSID). The PSID began in 1968 to study economic dynamics of U.S. households (10). The PSID included 6,241 families who participated in the study in both 1999 and 2001. In accordance with the coding schemes used in the original sample from 1968, any household with both a male and female was coded with males as heads and females as wives. In households with only one adult, heads of household may be either male or female. All heads and wives were recoded to be males and females regardless of their head-of-household status. This paper reports analyses conducted on women in PSID...
houses in 1999 and 2001. These two panels of data were the first to include the U.S. Department of Agriculture Household Food Security Survey Module for all households, heights and weights for heads and wives, and information about FSP participation. Analyses were based on a final sample of 5,303 after excluding women aged younger than 18 y or older than 74 y.

**Outcome.** The outcome of this study was weight change in women between 1999 and 2001. Heights and weights were reported by study respondents in pounds and inches. Weight change was calculated as the absolute difference in kilograms between 2001 and 1999 self-reported weights. For the purposes of regression analysis, all women who reported a weight change of >27.2 kg (50 lb) or < -27.2 kg were recoded as gaining or losing 27.2 kg to reduce the excessive influence of these values. Sensitivity analyses showed that this recoding did not alter the results.

**Exposure.** The primary exposures in this study were food insecurity and FSP participation. Food insecurity was measured using the 18-item scale of the U.S. Department of Agriculture Household Food Security Survey Module (11) with a reference period of the 12 mo prior to the administration of the questionnaire. This scale has been shown to be valid and reliable in the general population (12). A food security variable with four categories, food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger, was available in the 1999 dataset. In the 2001 data, only 89 of the households with a woman were classified as food insecure with moderate hunger or food insecure with severe hunger. Because of these small numbers, all food-insecure households were combined into a single category. Food security status in 1999 was referred to as the baseline food security status for the purposes of these analyses. FSP participation was calculated as the total dollar amount of food stamps received during the years 1999 and 2001. In analyses where changing food insecurity status was examined, a four-category variable was created to indicate whether the household was persistently food secure, became food insecure, or was persistently food insecure. In analyses where changing FSP participation was examined, the absolute difference between 1999 and 2001 dollar amounts was calculated.

Covariates were included based on previous research on weight gain and food insecurity. Individual covariates included weight status based on BMI (kg/m²), age (y), years of education completed (y), race (White, Black, Hispanic, and other), marital status (never married, married, cohabitation, widowed, divorced, separated), occupational status (professional/technical, managerial, service, or trades) (10), employment status (unemployed or not), number of sick days from work in the past year (d), self-rated health (excellent, very good, fair, or poor), amount of vigorous physical activity (<1 wk, 1 to 4 times/wk, 5 or more times/wk), smoking (none, <1 pack/d, 1 or more packs/d), alcohol consumption (<1 drink/d, 1 or more drinks/d). In analyses where changes in covariates are controlled, new categorical variables were created to indicate the direction of change.

Household covariates included in multiple regression analyses included ratio of household income to poverty (% calculated by dividing household income by corresponding yearly poverty threshold), child-care expenses ($/y), participation in other food assistance programs [dichotomous indicators for anyone in the household participating in the National School Lunch Program (NSLP), the Child and Adult Care Food Program (CACFP), or the Special Supplemental Nutrition Program for Women, Infants and Children (WIC)], number of people in the household, number of children in the household, whether there was a new child in the household between 1999 and 2001 (dichotomous), number of meals family eats together per week, and housing status (owns or rents). Two covariates were included to indicate the urbanicity of the household location (large, medium, or small metropolitan area, suburban, or rural) (13) and the region of the country (Northeast, South, North Central, or West) (14). In analyses where changes in covariates are controlled, new categorical variables were created to indicate the direction of change.

**Analyses.** All analyses presented in this paper were weighted to account for complex sampling, the entry of new families, and attrition. The PSID includes poststratification weights that calibrate the estimates to the demographic characteristics of the U.S. population (10). All analyses conducted that included data from both years were weighted by the 2001 sample weights. Analyses were conducted in STATA (15) using standard univariate, bivariate, and multivariate procedures and SVY commands (16).

Two types of regression models were used to estimate the effects of food insecurity and the interaction between food insecurity and FSP participation. First, a lagged model estimated the effect of changing food insecurity and changing program participation on subsequent weight change, controlling for potential confounders present at baseline. The value of this model was that it allowed for an examination of the timing of events related to weight change. That is, food insecurity status and Food Stamp Program participation precede the weight change, providing some additional information about the causal relations between these variables. Second, a dynamic model was used to estimate the effects of changing food insecurity and changing FSP participation, controlling for changing covariates and time-invariant covariates, such as race, on weight change. The value of the dynamic model was that the effects of simultaneous changes that accompany weight change were controlled for in examining the association between changing food insecurity status, changing FSP participation, and weight change. The dynamic model also controlled for initial status in all exposures and covariates. The dynamic model allowed for the inclusion of persistently food-insecure women, a subgroup of interest when examining the effects of food assistance participation.

**RESULTS**

Table 1 describes the baseline status of the sample of women with data available in the 1999 and 2001 panels of the PSID. On average, women in the PSID were overweight and gaining 1 kilogram or more of weight over the 2-y period. The majority of the women in this sample were food secure, middle-aged, and high-school educated, White, non-Hispanic, married, homeowners, and in service professions with incomes above 350% of the income-to-poverty ratio. Most women reported that their health was excellent or good, that they did not smoke or consume more than one alcoholic beverage per day, but that they were physically inactive. Food-insecure women differed from their food-secure counterparts in a number of ways at baseline. Food-insecure women were younger, had fewer years of completed education, and had lower salaries than their food-secure counterparts. More food-insecure women were Black or Hispanic, had never been married, or were divorced or separated, and worked in service or trades jobs. Food-insecure women reported fewer sick days, but more reported that their health was fair or poor, that they were physically inactive, and that they smoked than their food-secure counterparts. Food-insecure women lived in households with incomes that were below 185% of the poverty threshold on average, had a greater number of family members and children, had higher child-care expenses, consumed more meals with the family, and participated in more food assistance programs than food-secure women’s households. More food-insecure households were located in medium metropolitan households and in western states than in other areas.

Cross-sectional analysis of the PSID data indicated an association between weight status and both food insecurity status and FSP participation. The prevalence of overweight status among food-insecure women in 1999 was 61.3%, whereas the prevalence of overweight status among food-secure women was 56.7% (chi-squared = 30.1, P < 0.0000). Likewise, the prevalence of overweight status among FSP participants was 65.1%, whereas the prevalence of overweight status among nonparticipants was 47.3% (chi-squared = 51.3, P < 0.000).

In Table 2, the main effect of food insecurity on weight gain is shown using both lagged and dynamic models, and then the interactive effect of FSP is shown. Among women who changed food insecurity status, there were small, insignificant differences in weight change compared with those who were persistently food secure. Among women who were food insecure at both time
### TABLE 1
Characteristics of women in the 1999 PSID by their weight status and food security status in 1999

<table>
<thead>
<tr>
<th>Food security in 1999</th>
<th>All women</th>
<th>Secure</th>
<th>Insecure</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>5,503</td>
<td>5,406</td>
<td>447</td>
</tr>
<tr>
<td>Weight change, mean kg</td>
<td>1.1</td>
<td>1.1</td>
<td>0.8</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>25, %</td>
<td>55.2</td>
<td>56.4</td>
</tr>
<tr>
<td>25–29, %</td>
<td>27.3</td>
<td>27.2</td>
<td>31.3</td>
</tr>
<tr>
<td>≥30, %</td>
<td>17.4</td>
<td>16.4</td>
<td>25.4</td>
</tr>
<tr>
<td>Food insecure, %</td>
<td>5.1</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Annual FSP benefit, mean $</td>
<td>63</td>
<td>40</td>
<td>619</td>
</tr>
<tr>
<td>participants only</td>
<td>$1,974</td>
<td>$2,017</td>
<td>$2,560</td>
</tr>
</tbody>
</table>

**Woman's demographic characteristics**
- Age, mean y: 47.0, 47.5, 35.5
- Education, mean y: 13.0, 13.2, 10.5
- White, non-Hispanic, %: 78.9, 81.4, 44.9
- African-American, %: 11.7, 10.4, 23.6
- Hispanic, %: 5.6, 4.6, 26.1
- Other race or ethnicity, %: 3.8, 3.6, 5.5
- Never married, %: 11.4, 10.1, 22.2
- Married, %: 61.6, 64.6, 44.6
- Cohabitation, %: 3.6, 3.2, 7.3
- Widowed, %: 9.5, 9.4, 2.3
- Divorced, %: 11.4, 10.4, 15.9
- Separated, %: 2.6, 2.2, 7.8
- Professional or technical occupation, %: 27.5, 29.3, 7.9
- Management occupation, %: 13.0, 13.2, 9.2
- Service occupation, %: 48.4, 48.6, 56.6
- Trades occupation, %: 11.0, 8.9, 26.3
- Unemployed, %: 6.2, 5.2, 24.1
- Woman's salary, mean $ employed women only: $8,626, $9,317, $1,764
- $36,084, $36,936, $24,280

**Woman's health characteristics**
- Sick days, mean d/y: 6.0, 6.2, 3.8
- Self-rated health as excellent, %: 21.5, 22.9, 13.5
- Self-rated health as very good, %: 33.4, 34.8, 20.1
- Self-rated health as good, %: 30.5, 29.5, 42.0
- Self-rated health as fair or poor, %: 14.6, 12.8, 24.4
- Physically active <1 wk, %: 38.7, 37.4, 50.2
- Physically active 1–4 times/wk, %: 43.4, 44.6, 29.9
- Physically active 5 or more times/wk, %: 17.9, 18.3, 19.8
- >1 alcoholic drink/d, %: 7.4, 7.6, 3.1
- No smoking, %: 82.5, 83.7, 72.1
- <1 pack of cigarettes/d, %: 10.2, 9.5, 17.9
- 1 or more packs of cigarettes/d, %: 7.3, 6.8, 9.1

**Household characteristics**
- Income-to-poverty ratio, mean %: 457, 484, 174
- Child-care expenses, mean $: 342, 359, 572
- Households with member participant of NSLP¹, %: 7.9, 5.8, 55.9
- Households with member participant of WIC², %: 4.5, 3.4, 32.3
- Households with member participant of CACFP³, %: 1.6, 1.6, 4.6
- Household members, mean number: 2.7, 2.6, 4.1
- Number of children in household, mean: 0.8, 0.7, 2.3
- Households with new child between 1999 and 2001, %: 4.2, 4.4, 18.5
- Family eats together, mean number of meals/wk: 3.8, 3.9, 4.9

### DISCUSSION

There is concern that FSP participation may have unintended consequences for participants (7). Two recent studies have reported that program participation may be associated with small increases in weight in women, but these studies have been limited in terms of modeling and conceptual framework. In this study, a cross-sectional relation between food insecurity and overweight status existed at baseline, similar to the findings of Townsend and colleagues (1). When we examined the temporal sequence of food insecurity and weight change, we found that, when food insecurity precedes weight change but does not persist, there is no effect of food insecurity status on weight change. When women are persistently food insecure, there is an associated lower weight change of about 7 kg, as would be expected.

We have hypothesized that FSP participation would modify the effects of food insecurity on weight change. Among the persistently food insecure, full participation in the FSP (about $2,000) resulted in a higher weight change of 7.8 kg, according
to dynamic model estimation of the effects of program participation. Therefore, it is likely that FSP participation compensated for the effects of food insecurity on weight change and might increase weight gain among persistently food-insecure women by 0.8 kg over a 1-y period after controlling for other baseline and changing factors in the woman’s life. We cannot conclude from this small effect that FSP participation causes additional weight gain that would lead to obesity among the persistently food insecure. Notably, full participation in food stamps was not associated with additional weight gain among women who either became food secure or insecure.

A number of studies have suggested reasons that food insecurity may lead to obesity and may be of help in interpreting the findings of this study. Drewnowski (6) has hypothesized that food insecurity, or inadequate resources to purchase food, leads to the purchase and consumption of less costly, more energy-dense foods. It could be that full FSP participation, through the provision of 70% of the estimated food budget for the household, inadvertently encourages persistently food-insecure households to adopt budgeting strategies that lead to the purchase of low-cost, energy-dense foods over long periods of time.

A second viewpoint is that the cyclical nature of food purchases in the low-income household may have biological and psychological consequences. Some recent research has suggested that low-income families spend more money for food at certain times of the month and have other lean periods (17). A possible hypothesis is that the way in which food stamps are distributed (i.e. on a monthly basis) could contribute to cyclical food purchases. If these purchasing patterns lead to small increases in weight, then we might expect to see a relation between program participation and weight gain. The findings of this study, however, might be most consistent with a hypothesis that a third factor causes both obesity and FSP participation. The only significant differences found in this study were among women who were persistently food insecure. It is very likely that weight gain that leads to obesity, full participation in the FSP, and persistent food insecurity are the results of a long-standing process that was not adequately captured by the covariates included in our models. The effects of long-term material hardship and the resultant psychological stress could be examined in future studies with more observation points over time.

There were some limitations to this study. First, we have not used a fixed-effects model, which has been used by others to provide the most reliable estimates of the effects of FSP participation, while controlling for the effects of selection bias by only examining those households that join or leave the program. In this study, we elected to use the dynamic model because of the ability to examine the persistently food-insecure woman’s weight change and attempted to control for factors that may introduce selection bias related to program participation. Second, the body weights in the PSID are self-reported and therefore are likely to be underestimated by women. To the extent that under-reporting of weight is also related to food insecurity status and FSP participation, our results may underestimate the true relation between food insecurity, food stamps, and weight change. Further evaluation of the effects of the FSP on weight change should be done with measured heights and weights and with more observation points over time.

LITERATURE CITED

15. StataCorp. STATA version 8.1. College Station, TX: Stata Corporation; 2003.
16. StataCorp. STATA survey data. 8.0 ed. College Station, TX: Stata Corporation; 2003.

<table>
<thead>
<tr>
<th>Main effect of food insecurity</th>
<th>Interactive effect of FSP ($2,000 change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged model $\beta_1$, kg</td>
<td>Dynamic model $\beta_2$, kg</td>
</tr>
<tr>
<td>Persistently food secure</td>
<td>Reference</td>
</tr>
<tr>
<td>Became food secure</td>
<td>0.86</td>
</tr>
<tr>
<td>Became food insecure</td>
<td>0.85</td>
</tr>
<tr>
<td>Persistently food insecure</td>
<td>$-6.70$</td>
</tr>
</tbody>
</table>

1 Controls for initial weight, height, age, smoking history, self-reported health, marital status, physical activity, alcohol consumption, race, a new child in 2-y period, occupation, region of the country, urbanicity, income-to-poverty ratio, household participation in WIC, CACFP, NSLP, whether the family eats meals together, and number of people in the household, woman’s personal salary or hourly wage, child-care expenditures.

2 The dynamic model controls for all baseline characteristics in lagged model and changes those characteristics. Change in race was not considered in this analysis.

3 CACFP.

4 Significant at $P < 0.05$.