Participation in Food Assistance Programs Modifies the Relation of Food Insecurity with Weight and Depression in Elders

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Abstract

The relation of food insecurity in elders with outcomes such as overweight and depression, and the influence of participation in food assistance programs on these relations, has not been established. The aim of this study was to examine the relation between food insecurity and weight and depression in elders, and determine whether participation in food assistance programs modifies the effect of food insecurity on weight and depression. Two longitudinal data sets were used: the Health and Retirement Study (1996–2002) and the Asset and Health Dynamics Among the Oldest Old (1995–2002). The relation of food insecurity and participation in food assistance programs was assessed by multilevel linear regression analysis. Food insecurity was positively related to weight and depression among elders. Some analyses supported that food-insecure elders who participated in food assistance programs were less likely to be overweight and depressed than those who did not participate in food assistance programs. This finding implies that food assistance programs can have both nutritional and non-nutritional impacts. The positive impact of participation in food assistance programs of reducing or preventing poor outcomes resulting from food insecurity will improve elders' quality of life, save on their healthcare expenses, and help to meet their nutritional needs. J. Nutr. 137: 1005–1010, 2007.

Introduction

Overweight and depression contribute to health problems and expenditures in elders because of high prevalence and effects on morbidity, physical disability, and mortality (1–10). Food insecurity is potentially an important factor in overweight and depression. A positive relation has been found between food insecurity and overweight and depression among adult women and children (11–19). Compared with food-secure persons, food-insecure persons were more likely to be overweight and have depressive symptoms. Because designs were cross-sectional, however, these studies could not determine whether food insecurity causes these outcomes. Furthermore, several studies showed no relation between food insecurity and overweight (20,21). Laraia et al. (22) suggested that the positive association of food insecurity with overweight was probably accounted for by the influence of socioeconomic variables.

A common model for the experience of stress depicts that the presence of certain resources as conditioning variables modifies the relation between a stressor and poor outcomes (23,24). Given that food insecurity can be considered a stressor, social resources such as participation in food assistance programs (FAP) could alleviate at least part of the effect of food insecurity on poor outcomes such as overweight and depression. Prior findings on the effect of participation in FAP on overweight are inconsistent (12,25–28), however, probably due partly to study limitations.

This study examined the effect of participation in FAP on overweight and depression among elders, paying specific attention to overcoming some of the limitations of previous studies. The main hypotheses were that food insecurity causes greater weight and depression among elders, and that elders’ participation in FAP modifies this effect.

Methods

Data source and respondents. The study used 2 longitudinal survey data sets sponsored by the National Institute on Aging (29,30): Health and Retirement Study (HRS) and Asset and Health Dynamics Among the Oldest Old (AHEAD). HRS and AHEAD were designed to obtain nationally representative information on health, insurance coverage, financial status, family support systems, labor market status, and retirement planning, every 2 y since 1992 and 1993. HRS was conducted with individuals between the ages of 51 and 61 and their spouses, regardless of age, at the time of the 1st interview. The initial sample consisted of 12,652 persons from a national probability sample of 7607 households. AHEAD was a companion to HRS and included 7447 non-institutionalized persons aged ≥70 and their spouses regardless of age. Both HRS and AHEAD used multistage complex sampling with 4 distinct selection stages and the intentional oversampling of blacks, Hispanics, and Florida residents. The primary stage involved probability
proportionate to size selection of U.S. counties. The 2nd stage selected area segments within sampled primary stage units. The 3rd sampling stage was a systematic selection of housing units from an enumeration of the selected area segments. The 4th stage was the selection of an age-eligible person within a sampled housing unit. HRS and AHEAD were poststratified to known 1990 census household totals and, at the individual level, to the 1990 Public Use Microdata Sample file.

This study used data from 4 follow-up surveys (i.e., waves) beginning with 1995–1996 (1996, 1998, 2000, and 2002 for HRS and 1995, 1998, 2000, and 2002 for AHEAD), because food insecurity was measured starting in 1995. The age-eligible study sample numbered 9481 for HRS and 6334 for AHEAD (people who were >54 y of age for HRS and >71 y of age for AHEAD in 1996 and 1995, respectively). The mean age of respondents was 60.8 ± 4.2 for HRS and 79.6 ± 5.8 for AHEAD. The prevalence of food insecurity (modified measure, see below) was 8.4% for HRS and 6.7% for AHEAD, showing higher rate for HRS and similar for AHEAD compared with 6.5% from national survey data for the years 1995–2004 (31). HRS and AHEAD estimated individual prevalence, whereas the national survey data estimated household prevalence. In the national survey data, households with elders had lower prevalence than households without elders (Table 1). Because personal identifiers were not used, this study was exempted from human subjects review.

**Independent variables.** Relative weight was assessed using BMI (kg/m²), calculated with respondents’ self-reported weight and height. It was used as a continuous variable in linear regression analyses and as an overweight and nonoverweight dichotomy in logistic regression analysis. BMI was categorized (32) as: weight and nonoverweight dichotomy in logistic regression analysis.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>HRS</th>
<th>AHEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>60.8 ± 4.2</td>
<td>79.6 ± 5.8</td>
</tr>
<tr>
<td>Gender, % male</td>
<td>52.3</td>
<td>40.1</td>
</tr>
<tr>
<td>Race/ethnicity, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>81.2</td>
<td>87.4</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>18.8</td>
<td>12.6</td>
</tr>
<tr>
<td>Marital status, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married and living together</td>
<td>75.0</td>
<td>51.9</td>
</tr>
<tr>
<td>Never married/divorced/widowed</td>
<td>25.0</td>
<td>48.1</td>
</tr>
<tr>
<td>Current job status, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working</td>
<td>53.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Not working</td>
<td>46.5</td>
<td>94.1</td>
</tr>
<tr>
<td>Education, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No formal education</td>
<td>0.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Less than high school</td>
<td>24.2</td>
<td>38.8</td>
</tr>
<tr>
<td>Graduated high school</td>
<td>36.3</td>
<td>31.4</td>
</tr>
<tr>
<td>Some college</td>
<td>19.4</td>
<td>15.4</td>
</tr>
<tr>
<td>College grad</td>
<td>8.8</td>
<td>6.9</td>
</tr>
<tr>
<td>Post college grad</td>
<td>10.9</td>
<td>6.3</td>
</tr>
<tr>
<td>Income, $/y</td>
<td>52,602 ± 74,783</td>
<td>27,760 ± 40,088</td>
</tr>
<tr>
<td>ADL, n</td>
<td>0.5 ± 1.1</td>
<td>1.0 ± 1.6</td>
</tr>
<tr>
<td>IADL, n</td>
<td>0.4 ± 0.8</td>
<td>0.9 ± 1.4</td>
</tr>
<tr>
<td>Diseases, n</td>
<td>1.6 ± 1.3</td>
<td>2.0 ± 1.3</td>
</tr>
<tr>
<td>Modified food insecurity, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation in programs, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food stamp program</td>
<td>5.1</td>
<td>4.6</td>
</tr>
<tr>
<td>Home-delivered meals</td>
<td>0.4</td>
<td>2.8</td>
</tr>
</tbody>
</table>

1. Values are means ± SD unless otherwise noted.
2. Activities of daily living.
3. Instrumental activities of daily living.

Depression was assessed by an 8-item version of the Center for Epidemiologic Studies-Depression (CES-D) scale. It included dichotomous questions about depression, happiness, loneliness, sadness, enjoyment of life, effort to do things, restless sleep, and ability to “get going” during the past week. The total CES-D score ranged from 0 to 8. A cutoff of >4 was used to identify those with depression (33).

| TABLE 1 Characteristics of study respondents at the first wave studied (1995–1996) |

Data analysis. Prevalence of overweight and depression over time were estimated using sampling weights to adjust for unequal selection probabilities and differences in response rates (40,41). The HRS and AHEAD includes poststratification weights that calibrate the estimate to the demographic characteristics of the U.S. elderly population. Weights from each wave were highly correlated, so the weight variable for 1998 was used. The relations among food insecurity, participation in FAP, and outcomes were assessed by a weighted multilevel linear regression analysis using 3 different models that account for variation within an individual: 1) current, 2) lagged, and 3) difference. These models have various advantages and disadvantages.

The effect of current food insecurity (FIS) and the effect of its interaction with participation in FAP on current outcomes were examined using the current model:

\[ \text{Outcome}_1 = \text{FIS} + \text{FAP} + \text{FIS} \times \text{FAP} + \text{Covariates}, \quad t = 1 \to 4. \]
The current model captures the effect of food insecurity on outcomes in a timely manner, but the direction of causality is questionable; the outcomes may influence contemporaneous food insecurity.

For the lagged and the difference model, 4 waves were combined to make 3 intervals of 2 successive time points, so we used observations for waves 1, 2, and 3 as explanatory variables, and waves 2, 3, and 4, respectively, as dependent variables. The lagged model assessed whether previous food insecurity was related to subsequent change of outcomes, and whether there was an interaction effect of previous food insecurity and previous participation in programs on subsequent change of outcomes.

Outcome, \(-\text{Outcome}_{t} = \text{FIS}_{t} + \text{Covariates}_{t}, t = 2 \text{ to } 4\)

Outcome, \(-\text{Outcome}_{t} = \text{FIS}_{t} + \text{FAP}_{t} + \text{FIS}_{t} \times \text{FAP}_{t} + \text{Covariates}_{t}, t = 2 \text{ to } 4\).

The lagged model better establishes the direction of effect than the current model, and distinguishes it from reverse causality by substituting lagged (i.e., earlier) food insecurity (41). This model may not capture the effect of food insecurity accurately if the 2-y period is the wrong period of time in which to see the effect. In addition, the lagged model cannot control for unobserved variables that affect outcomes and are also correlated with food insecurity. Thus, the effect of food insecurity on outcomes could be biased by unobserved factors.

The difference model examined whether the change in food insecurity was related to the change of outcomes, and whether the effect of the change in food insecurity on the change of outcomes was modified by the change of participation in programs.

\[ \Delta \text{Outcome} = \Delta \text{FIS} + \Delta \text{time-varying covariates} + \text{time-invariant covariates}, (\Delta \text{Variable} = \text{Variable}_{t-1}, t = 2 - 4) \]

\[ \Delta \text{Outcome} = \Delta \text{FIS} + \Delta \text{FAP} + \Delta \text{FIS} \times \Delta \text{FAP} + \Delta \text{time-varying covariates} + \text{time-invariant covariates}. \]

The difference model can eliminate the effects of unobserved factors using differences within the same person but cannot establish the direction of causality (42).

Dropout and death rates were examined to assess any potential selection bias. The dropout rate was <3% at each wave for HRS and <4% at each wave for AHEAD. Death rate was <3% in HRS and 13% in AHEAD, and there was no association between food insecurity and death in AHEAD. Because dropout and death rates were low and not related to food insecurity, sampling attrition was considered ignorable (43). All analyses were conducted in SAS software (version 8.0, SAS Institute) with \( P < 0.5 \) as a reference \( P \)-value. As noted in the equations above, interactions between FIS and FAP were modeled as product terms, with FAP representing the dichotomy of participants vs. nonparticipants.

**Results**

From wave 1 (1995–96) to wave 4 (2002) mean BMI and prevalence of overweight slightly increased over time in HRS from 27.3 to 27.6 kg/m² and from 65.8 to 67.9%, but decreased slightly in AHEAD from 25.1 to 24.9 kg/m² and from 46.4 to 44.6%, respectively. From wave 1 to wave 4 depression (3.1 to 3.6 for HRS and 2.9 to 3.5 for AHEAD) and prevalence of depression (26.0 to 39.4% for HRS and 21.0 to 33.3% for AHEAD) increased over time.

For AHEAD, current food-insecure elders had higher BMI than current food-secure elders by 0.19 unit of BMI (\( P < 0.033 \)) (Table 2). In the lagged model, previous food-insecure elders had a greater change in BMI than previous food-secure elders by 0.16 (\( P < 0.1 \)) for AHEAD. As elders became food insecure after being food secure, their BMI increased by a mean of 0.3 for AHEAD (\( P < 0.025 \)). For HRS, food insecurity was not related to BMI (Table 2). When the HRS respondents were categorized into 2 groups based on BMI level (<25 kg/m² and \( \geq 25 \) kg/m²), those with food insecurity increased BMI for the higher BMI group (\( \beta = 0.35, P < 0.004 \)) in the lagged model but did not for the lower BMI group (\( \beta = 0.06, P < 0.564 \)).

As for depression symptoms, current food-insecure elders had higher depression scores than food-secure elders in both HRS (\( \beta = 0.27, P < 0.001 \)) and AHEAD (\( \beta = 0.18, P < 0.051 \)). Previous food-insecure elders also had a greater change in depression score than previous food-secure elders by 0.16 (\( P < 0.05 \)) in HRS.

For HRS, interactions between food insecurity and participation in FAP on BMI were not significant (Table 3). For AHEAD, food insecurity was positively related to BMI among nonparticipants in the Food Stamp Program for the current and lagged models, but was not related to BMI among participants.

For HRS with the current model, food insecurity and Food Stamp Program participation influenced the occurrence of depression symptoms (\( P < 0.004 \)) (Table 4). The interaction for the homedelivered meals program with the difference model was marginally significant (\( P < 0.06 \)). For both, food insecurity was positively associated with depression among nonparticipants but not among participants.

**Discussion**

BMI and prevalence of overweight slightly increased over time in HRS but slightly decreased in AHEAD. The reason for different patterns of BMI and overweight between HRS and AHEAD could be a birth-cohort effect resulting from different life experiences of the 2 groups born at different times. Another possible reason is an age-related effect such that declining weight with age is reflective of declining health and biological changes. Estimates of overweight from NHANES III and NHANES 1999–2000 available by age and level of overweight (44,45) showed similar patterns with age.

![Table 2](https://academic.oup.com/jn/article-abstract/137/4/1005/4664591)
In general, food insecurity was positively related to depression in HRS and to both BMI and depression in AHEAD. Other studies of women and children showed a similar association between food insecurity and overweight (11,12,14,18). Several explanations have been suggested for the relation of food insecurity and overweight. Episodic food shortages could cause individuals to overeat when there is enough food and adapt to increased body fat. Limited economic resources might also encourage food-insecure persons to purchase cheap and high energy-dense foods that would result in weight gains (14,46–48). Because food insecurity is a stressor, food-insecure persons may cope with stress by eating unrestrainedly or excessively and thus experience higher body weight (27,49). Future research should aim to understand the experiences and behaviors of food-insecure people that result in this link between food insecurity and overweight.

The positive association of food insecurity with depression can be explained by the relation between stressors and depression. Environmental adversity, disadvantage, and stressful events, especially those associated with low socio-economic status, are known to contribute to the onset of depression symptoms (50,51). Therefore, it is plausible that being food insecure can cause depression. Other studies have also found that the stress of food deprivation caused depression (52,53). Depression is associated with disability, which is highly prevalent in elders (54–57). Food insecurity is a risk factor for disability (58), which could occur in part through depression.

Participation in FAP modified the relation between food insecurity and BMI and depression. The positive effect of previous food insecurity on subsequent change of BMI did not occur when food-insecure elders participated in the Food Stamp Program in AHEAD. Similarly, depression score decreased slightly for elders who became food insecure after being food secure among home-delivered meal participants in HRS.

Previous studies on the effect of participation in FAP on overweight reported various findings. Participation in FAP was associated with a high risk of overweight in Townsend et al. (12) and in Gibson’s studies (25,28), and with a low risk of overweight in a study by Jones et al. (26). Townsend et al. (12) and Jones et al. (26) used cross-sectional data so that they could not verify the direction of causality in their findings. Gibson’s studies (25,28) could not include food insecurity in the analysis model, which likely biased the estimates of the relation between participation in FAP and overweight, because food insecurity probably influences both participation in FAP and being overweight.

A positive effect of government programs on depression was also shown by Rodriguez et al. (59). They found that receipt of government entitlement benefits was associated with a long-term reduction in depression symptoms among unemployed women.

This study found plausible evidence that food insecurity is related to increased weight and depression in elders. We used 2 longitudinal data sets and accounted for possible confounding factors in the regression models. In addition, we analyzed the data with various statistical approaches for longitudinal data because each model has both strengths and limitations. This study also found some evidence that the effect of food insecurity on weight and depression was modified by participation in FAP, although the results were not consistent across models and data sets. The samples were representative of the U.S. elderly population, strengthening the generalization of the findings. Using different-aged populations in the analyses allowed us to test consistency of findings.

The use of BMI calculated by self-reported measures of height and weight could have created measurement error. Elders could have reported a weight that they maintained for most of their adult life rather than an accurate current weight. Furthermore, BMI may not accurately represent the component of body fat, as it is assumed to do in younger adults. Several factors, such as skeletal muscle mass or bone loss due to aging, the presence of disease processes, or a reduction in height due to vertebral fractures caused by osteoporosis may have influenced the accuracy of using BMI as an assessment of body fat in elders (60, 61). Thus, we compared the distribution of BMI and prevalence of overweight in this study with NHANES III and NHANES 1999–2000 data (44,45) to confirm the accuracy of BMI. There were no important differences among these data. Using BMI in

### TABLE 3

Regression coefficients representing the effects of food insecurity on BMI according to participation in food assistance programs

<table>
<thead>
<tr>
<th>Model</th>
<th>Food stamp program</th>
<th>Home-delivered meals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$ for NP$^1$ $\beta$ for PP$^2$ $P$-value$^3$</td>
<td>$\beta$ for NP$^1$ $\beta$ for PP$^2$ $P$-value$^3$</td>
</tr>
<tr>
<td>HRS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current$^4$</td>
<td>-0.07</td>
<td>-0.34</td>
</tr>
<tr>
<td>Lagged$^6$</td>
<td>0.20</td>
<td>0.15</td>
</tr>
<tr>
<td>Difference$^6$</td>
<td>-0.20</td>
<td>-2.05</td>
</tr>
<tr>
<td>AHEAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current$^4$</td>
<td>0.24</td>
<td>-0.14</td>
</tr>
<tr>
<td>Lagged$^6$</td>
<td>0.47</td>
<td>-0.03</td>
</tr>
<tr>
<td>Difference$^6$</td>
<td>0.40</td>
<td>0.24</td>
</tr>
</tbody>
</table>

1 Nonparticipation in programs.
2 Participation in programs.
3 Interaction for food insecurity and participation in programs.
4 Controlled for current age, sex, marital status, education, income, number of chronic diseases, physical activity, activities of daily living, instrumental activities of daily living, and smoking status.
5 Controlled for previous BMI and previous characteristics in current model for BMI.
6 Controlled for changes in characteristics in lagged model for BMI, and for race, sex, and education.

### TABLE 4

Regression coefficients representing the effects of modified food insecurity according to participation in food assistance programs on depression

<table>
<thead>
<tr>
<th>Model</th>
<th>Food stamp program</th>
<th>Home-delivered meals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$ for NP$^1$ $\beta$ for PP$^2$ $P$-value$^3$</td>
<td>$\beta$ for NP$^1$ $\beta$ for PP$^2$ $P$-value$^3$</td>
</tr>
<tr>
<td>HRS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current$^4$</td>
<td>0.33</td>
<td>-0.01</td>
</tr>
<tr>
<td>Lagged$^6$</td>
<td>0.15</td>
<td>0.11</td>
</tr>
<tr>
<td>Difference$^6$</td>
<td>0.08</td>
<td>-0.13</td>
</tr>
<tr>
<td>AHEAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current$^4$</td>
<td>0.01</td>
<td>0.06</td>
</tr>
<tr>
<td>Lagged$^6$</td>
<td>0.20</td>
<td>0.15</td>
</tr>
<tr>
<td>Difference$^6$</td>
<td>0.10</td>
<td>0.51</td>
</tr>
</tbody>
</table>

1 Nonparticipation in programs.
2 Participation in programs.
3 Interaction for food insecurity and participation in programs.
4 Controlled for current age, sex, marital status, education, income, number of chronic diseases, physical activity, activities of daily living, instrumental activities of daily living, and social interaction.
5 Controlled for previous CES-D characteristics in current model for CES-D.
6 Controlled for changes in characteristics in lagged model for CES-D, and race, sex, and education.
the elderly population is, however, less sensitive than in adults to assess effects of relative weight on morbidity or mortality (62).

In conclusion, food insecurity was generally related to a greater relative weight in the oldest group of elders and greater depression among both groups of elders in this study. The relation of food insecurity with BMI and depression was modified by participation in FAP in some analyses. When food-secure elders participated in FAP, in general, food insecurity did not appear to increase weight and depression. These findings imply that food insecurity and food assistance programs can have both nutritional and non-nutritional impacts. The positive impact of participation in FAP for reducing or preventing the risk of poor outcomes resulting from food insecurity will improve elders’ quality of life and save on their healthcare expenditures in addition to meeting their nutritional needs. These findings on the multiple impacts of participation in FAP support further development of these programs for elders.

**Literature Cited**


