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Nutritional Consequences of Food Insecurity in a Rural New York State County

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Abstract

This study of women with children in a rural county of upstate New York examined the relationships of food insecurity and income with two nutritional consequences (adiposity and fruit and vegetables consumption), and assessed whether disordered eating patterns is a mediator for the effects of food insecurity and income on these nutritional consequences. Each of 193 respondents was interviewed twice in her home. Data were collected on household food stores, socioeconomic and demographic characteristics, methods of obtaining food, food program participation, household expenditures, food intake, the Radimer/Cornell hunger and food insecurity items, height, weight, frequency of fruit and vegetable consumption, and disordered eating patterns. Regression analysis was used to analyze the relationships of body mass index and an obesity classification with height, income, education, single parenthood, employment, food insecurity, disordered eating, and frequency of fruit and vegetable consumption. Regression analysis was also used to examine the relationships of disordered eating and frequency of fruit and vegetable consumption with the other variables.

Lower income and unemployment were related to higher adiposity. The effects of income on adiposity were not mediated through disordered eating patterns or through fruit and vegetable consumption. Food insecurity was related to adiposity, and part of this effect of food insecurity was mediated through disordered eating. This mediating effect of disordered eating partially explained why those experiencing the least severe food insecurity were more likely to be overweight than those who were food secure, but those experiencing the most severe food insecurity were less likely to be overweight than those who were food secure. Food insecurity was related to lower fruit and vegetable consumption, but this did not translate into effects on adiposity.

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INTRODUCTION

Food insecurity is a public policy concern for food-rich countries such as the United States and Canada, as well as for developing counties (Food and Consumer Service 1994; Maxwell and Frankenberger 1993). Food insecurity is defined as "whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain" (Anderson 1990). Campbell (1991) elaborated a conceptualization of food insecurity that included factors contributing to it and factors that were consequences of it. Two possible nutritional consequences of food insecurity of particular concern from a public health perspective in food-rich countries are overweight (i.e., excessive adiposity) and consumption of poor-quality diets.

Overweight is a serious public health concern in the United States and similar food-rich countries (Kuczmarski et al. 1994). Overweight is associated with adverse health outcomes (Troiano et al. 1996) and with large economic, social, and psychological costs (Sobal 1991; Kuczmarski et al. 1994). In the United States, the prevalence of overweight has been increasing in both adults (Kuczmarski et al. 1994) and children (Troiano et al. 1995). In developed countries, overweight is known to be related to socioeconomic status, especially among women (Federation of American Societies for Experimental Biology 1995; Sobal and Stunkard 1989; Rolland-Cachera and Bellisle 1986). Women with lower income or social class are more likely to be overweight.

The reasons that people of lower socioeconomic status are more prone to be overweight are not understood. Past investigators have found no clear relationship between energy consumption and adiposity in either adults (McCarthy 1966; Ries 1973; Kromhout 1983; George et al. 1989, 1991) or children (Rolland-Cachera and Bellisle 1986). Jiang and Hunt (1983), in a metabolic study of men, found that adiposity was not related to energy consumption, but was related to energy density per meal. Miller et al.

(1990) have also reported that diet composition was related to adiposity. Others have found no relationship (Beaudoin and Mayer 1953). Some other possible mediating factors are physical activity, social mobility, and genetic inheritance (Sobal and Stunkard 1989).

The most likely mediating factor between income and overweight in women is eating patterns. Sobal and Stunkard (1989) concluded that dieting and dietary restraint are probably the most important factors mediating the relationship between social class and overweight in women. Metzner et al. (1977) found that frequency of eating was inversely related to adiposity, but the causal direction is unclear. Bernstein et al. (1981) found that the duration between meals was positively related to the energy consumed per meal when men lived for an extended period in the absence of time cues. This implies that there is a natural regulation of intake. They suggested that, when people schedule meals for social or time reasons, this regulation might be negated.

The relationship between socioeconomic status and dietary consumption has not been as extensively studied as it has for overweight. In the United States, people with low incomes have lower intakes of fruits and vegetables than those with higher incomes (Thompson et al. 1992).

The relationship between food insecurity and overweight or dietary consumption has been even less studied. A major reason for this lack of information has been the lack until recently of a suitable means of assessing food insecurity (Kendall et al. 1995, 1996; Frongillo et al. 1995). In the United States, those with food insufficiency or food insecurity have lower intakes of fruits and vegetables, as well as lower consumption of energy and other nutrients (Cristofar and Basiotis 1992; Kendall et al. 1996).

Disordered eating is a common problem among obese individuals (Marcus 1995). Little is known about what factors contribute to disordered eating, but characteristics such as vulnerability, anxiety, and low self-esteem have been theorized as being important (Cooper 1995). Given that low socioeconomic status and, specifically, food insecurity lead to uncertainty in people’s lives, disordered eating is one

possible mechanism to explain why those with lower socioeconomic status are more prone to be overweight.

The objectives of this study of rural women with children were (1) to examine the relationships between food insecurity and income with two nutritional consequences: adiposity and dietary consumption of fruits and vegetables, and (2) to assess whether disordered eating patterns is a mediator for the effects of food insecurity and income on these nutritional consequences.

METHODS

Population

The study took place in a rural county of upstate New York that had a population of 60,517 in 1990 (Eberts 1994). Nearly 77 percent of the population of this county live in places with fewer than 2,500 people. In 1990, the unemployment rate of the county was 5.8 percent; per capita income was $15,503; and the percentage of families in poverty was 12.6 percent. This county was below both the mean unemployment rate and the poverty rate for similar counties in upstate New York. A rural population was selected because the overall poverty rate is higher in rural than urban areas (Deavers and Hoppe 1993) and because the rural poor have fared relatively badly since 1980 as the economic performance of rural areas has lagged behind that of the rest of the nation. Obesity is also slightly greater in rural areas (Sobal et al. 1996). In 1993 when the study reported here was conducted, the nonmetropolitan poverty rate was 17.2 percent while the metropolitan poverty rate was 14.6 percent (U.S. Department of Commerce 1995).

Selection of the Sample

A survey of women with children living in their household was conducted in this county between January and July 1993. A sample of approximately 200 women was desired because previous research, with a sample size of 189, found statistically significant relationships between food insecurity and factors

contributing to it (Radimer et al. 1992). The sampling frame was a 1989 health census of the county which had a participation rate of 86 percent. Women over the age of 40 and those with 16 or more years of education were excluded, resulting in 3,433 women who were eligible for the study. Since it was anticipated that changes in the county's population had taken place since the health census was completed, a pool of 639 women was selected from the census.

Six strata were formed based on the demographic characteristics available from the census most strongly associated with low socioeconomic status: first, whether potential subjects did or did not have a telephone; and then, whether they had private health insurance, Medicaid insurance, or no health insurance. Each of the six strata was further stratified into five age groups: 15–19, 20–24, 25–29, 30–34 and 35–39 years. Fifty-two percent of the women (331) could not be located within the county despite intensive efforts. The remaining 308 women were contacted by telephone or, for those with no phones, at their homes to request their participation and to set up interviews. Two hundred women agreed to participate in the survey. Refusal rates were 18 percent in the strata presumed to be the lowest income group (those having no telephone and either Medicaid or no health insurance), 40 percent in the fifteen intermediate strata and 32 percent in the five highest strata (those with a telephone and private health insurance). Seven of the 200 women fell into the 15–19 age category; they were dropped from the analysis, leaving an analytic sample of 193.

Data Collection

Each respondent was interviewed twice in her home. During the first interview, a questionnaire was administered and an inventory of household food stores was conducted by trained field workers. The questionnaire obtained information on sociodemographic characteristics, methods of obtaining food, food program participation, household expenditures, food intake, and the Radimer/Cornell hunger and food insecurity items (Kendall et al. 1995). At the second interview, approximately three weeks later, the household food inventory was repeated. Each respondent's height and weight was measured during the first

interview. At both interviews, a 24-hour food recall was taken. A survey about the frequency of fruit and vegetable consumption was administered during the first interview (Serdula et al. 1993).

The survey instrument was pretested in a sample of 20 low-income women and afterward a number of categories on the food inventory instrument were revised to better differentiate household food stores. The study protocol was approved by the Cornell University Human Subjects Committee and informed consent was given by all respondents prior to participation in the study. Each respondent received $20 as compensation for participating in the survey.

Conceptual Model

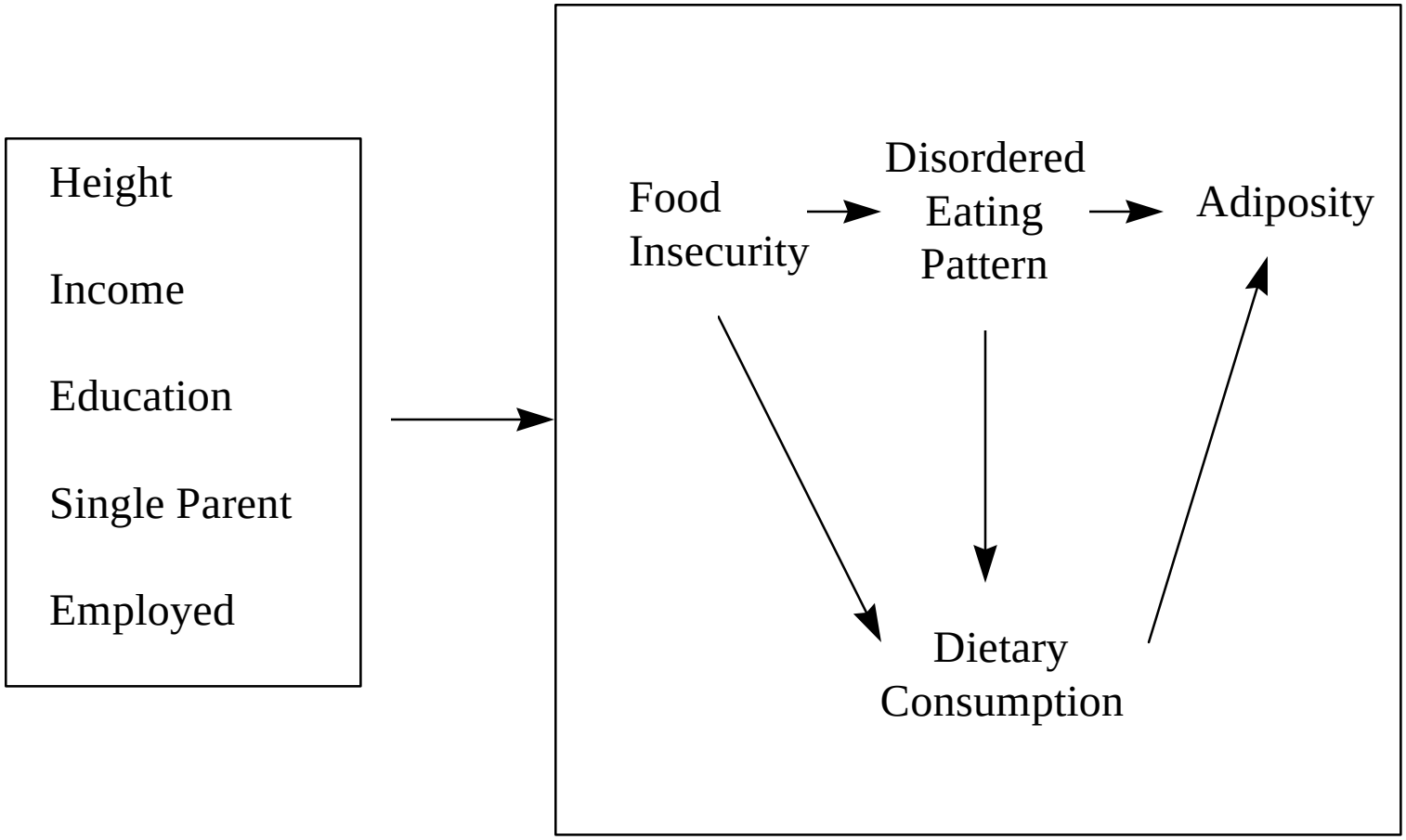
The conceptual model that guided the variables used and the analysis undertaken is shown in Figure 1. According to this model, adiposity is determined by food insecurity, disordered eating patterns, and dietary consumption. Each of these variables, including adiposity, is influenced by income, education, being a single parent, and being employed. Height was included in the model to ensure that differences in body frame would not confound any of the other relationships examined.

Measurement of Variables

Two outcome variables for adiposity were analyzed: body mass index (BMI) and obesity. Each respondent's BMI was calculated by taking her measured weight in kilograms and dividing by the square of her measured height in meters. Respondents with BMI greater than 29 were classified as obese (Institute of Medicine 1990).

This study used the Radimer/Cornell hunger and food insecurity measure previously validated for identifying groups of food insecure households (Kendall et al. 1995) and individual households (Frongillo et al. 1995). This measure was developed using both qualitative and quantitative research methods (Radimer et al. 1990, 1992). Each respondent was categorized into one of four food insecurity

Figure 1
Model of Consequences of Food Insecurity



groups based on their responses to the Radimer/Cornell food insecurity items (Kendall et al. 1995). The Household Insecure group included all those who answered affirmatively only to the four items related to food insecurity at the household level. The Individual Insecure group answered affirmatively to the three items about adult food insecurity or to an item about the quality of children's diets but not to items about the quantity of children's intakes. The Child Hunger group answered affirmatively to one or more items about the quantity of children's intake. Three dummy variables were used to represent these categories and the fourth category, Food Secure, those who answered negatively to all food insecurity items, was used as the comparison group.

Four yes/no questions about food consumption patterns indicative of disordered eating behaviors from the Stanford Eating Disorders Questionnaire (Agras 1987) were included on the survey. A score was constructed by summing over the questions. Each respondent was asked whether she (1) has abnormal or unusual eating patterns compared to others in terms of how much she eats or how fast she eats; (2) ever eats large amounts of food very quickly in a short period of time; (3) ever has episodes of overeating that she would refer to as binges, and (4) eats large quantities of food deliberately out of the sight of other people. Higher scores indicate more disordered eating.

Dietary consumption was measured by the frequency of fruit and vegetable consumption. A score was calculated by summing over the reported weekly frequency of consumption of all fruits and vegetables included in the food frequency questionnaire. We were also interested in using energy intake as a measure of dietary consumption. However, previous analysis with this sample demonstrated that, even with two 24-hour recalls available, energy intake was not assessed reliably enough to examine relationships with the four food insecurity groups (Kendall et al. 1996). Preliminary analyses for this paper indicated that energy intake was not related to BMI. For these two reasons, energy intake is not considered further in the paper.

Income was measured by six categories (less than $5,000, $5,000–$10,000, $10,000–$15,000, $15,000–$20,000, $20,000–$25,000, and greater than $25,000) and was treated as continuous. Other

social and economic characteristics of respondents were education (classified as less than high school graduate, high school graduate, some college or technical training, and college graduate and treated as continuous), whether or not the respondent was a single parent, and whether or not the respondent was employed.

Statistical Analysis

A sequence of linear regression analyses was used to analyze the relationships between height, income, education, single parenthood, employment, food insecurity, disordered eating, and frequency of fruit and vegetable consumption and BMI. A sequence of logistic regression analyses was used similarly to analyze the relationships between these variables and obesity. Regression analysis was also used to examine the relationships of the two dietary variables, disordered eating and frequency of fruit and vegetable consumption, with height, income, education, single-parent household, respondent's employment, and food insecurity. All analyses were done in SAS (SAS Institute 1989) using weighted data.

A sequence of six models was run for both BMI and obesity as outcome variables. Model 1 had as a covariate only height, ensuring that any residual relationship of height with BMI and obesity was controlled. Model 2 had as covariates height and income. Model 3 had as covariates height, income, education, single parent, and employed. Model 4 added to Model 3 the covariates for household insecure, individual insecure, and child hungry. Model 5 added to Model 4 the covariate disordered eating. Model 6 added to Model 5 the covariate fruit and vegetable consumption.

RESULTS

Table 1 presents the summary statistics for the fit of the six models with BMI and obesity as outcomes. For BMI, coefficients of determination (R^2) for each model are presented, along with the F-statistic comparing each model with the previous one in the sequence. For obesity, -2 log-likelihood values

for each model are presented, along with chi-square statistics comparing each model with the previous one in the sequence. For BMI, the addition of disordered eating had a large effect on the model fit. For obesity, the additions of income; education, single parent, and employed; and disordered eating had large effects on the model fit.

Table 2 presents the regression coefficients and corresponding p-values for the six models with BMI as an outcome. In Models 2–6, the effect of income was negative, meaning that higher income was associated with lower BMI. In Models 3–6, the effects of education and single parenthood were not important. In these models, the effect of employment was negative, meaning that being employed was associated with lower BMI. In Models 4–6, household food insecurity (i.e., compared to food security) was associated with higher BMI. Individual insecurity and child hunger were not strongly associated with BMI, although the coefficient for child hunger was negative. In Models 5–6, the effect of disordered eating was positive, meaning that those with disordered eating patterns had higher BMI. In Model 6, fruit and vegetable consumption was weakly positively associated with BMI.

With obesity as an outcome, the results for the effects of income and employment (Table 3) are similar to those for the effects on BMI. Unlike with BMI, the effect of household food insecurity on obesity was small, but the effect of child hunger was large and negative, meaning that those reporting child hunger were less likely to be obese. As with BMI, the effect of disordered eating on obesity was positive.

The effects of the other covariates on disordered eating and fruit and vegetable consumption are presented in Table 4. For all three insecurity categories, disordered eating was higher while fruit and

TABLE 1
Overall Fit of the Sequence of Models for BMI and Obesity

	BMI		*Obesity (BMI > 29)*	
Model	R^2	F	-2 LL	Chi-square
1	0.5	0.78	332.0	0.69
2	2.1	2.93	331.3	4.26
3	4.4	1.38	322.9	8.45
4	7.3	1.70	317.9	4.98
5	10.2	5.42	307.4	10.45
6	11.3	2.08	306.2	1.21

Covariates in models:

Model 1 height
2 height, income
3 height, income, education, single parent, employed
4 height, income, education, single parent, employed, household insecure, individual insecure, child hungry
5 height, income, education, single parent, employed, household insecure, individual insecure, child hungry, disordered eating
6 height, income, education, single parent, employed, household insecure, individual insecure, child hungry, disordered eating, fruit and vegetable consumption

TABLE 2
Regression Coefficients and P-Values from Multiple Linear Regressions with BMI as the Outcome

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coeff	P	Coeff	P	Coeff	P	Coeff	P	Coeff	P	Coeff	P
Constant	36.76	0.00	36.68	0.00	36.41	0.00	34.71	0.00	29.57	0.01	28.39	0.02
Height	-0.06	0.38	-0.05	0.48	-0.04	0.56	-0.04	0.63	-0.04	0.60	-0.04	0.60
Income			-0.46	0.09	-0.40	0.22	-0.44	0.20	-0.39	0.25	-0.38	0.25
Education					-0.03	0.95	-0.01	0.98	0.04	0.94	-0.12	0.83
Single Parent					-0.33	0.81	-0.74	0.60	-0.69	0.61	-0.52	0.71
Employed					-1.96	0.06	-1.75	0.09	-1.94	0.06	-2.12	0.04
Household Insecure							2.27	0.06	1.93	0.11	2.20	0.07
Individual Insecure							0.07	0.96	-0.31	0.82	-0.01	1.00
Child Hunger							-0.90	0.62	-1.64	0.37	-1.14	0.54
Disordered Eating									1.12	0.02	1.44	0.02
Fruit & Vegetable Consumption										0.05	0.15	

TABLE 3
Regression Coefficients and P-Values from Multiple Logistic Regressions with Obesity (BMI > 29) as the Outcome

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coeff	P	Coeff	P	Coeff	P	Coeff	P	Coeff	P	Coeff	P
Constant	1.85	0.58	1.80	0.59	2.16	0.52	1.88	0.59	-0.23	0.95	-0.55	0.88
Height	-0.02	0.41	-0.01	0.53	-0.02	0.44	-0.01	0.56	-0.01	0.54	-0.01	0.55
Income			-0.16	0.04	-0.16	0.08	-0.21	0.03	-0.20	0.04	-0.20	0.04
Education					0.22	0.16	0.20	0.22	0.22	0.17	0.19	0.26
Single Parent					-0.00	0.99	-0.05	0.91	-0.02	0.95	0.00	0.99
Employed					-0.47	0.10	-0.44	0.13	-0.54	0.07	-0.59	0.05
Household Insecure							0.17	0.61	0.04	0.91	0.10	0.79
Individual Insecure							-0.31	0.45	-0.49	0.25	-0.42	0.32
Child Hunger							-1.00	0.09	-1.34	0.03	-1.24	0.05
Disordered Eating									0.45	0.00	0.47	0.00
Fruit & Vegetable Consumption										0.01	0.27	

TABLE 4
Regression Coefficients for the Effects of Other Covariates on Disordered Eating and Fruit and Vegetable Consumption

	Disordered Eating		Fruit/Vegetable Consumption	
Covariates	Coefficient	P-value	Coefficient	P-value
Constant	4.61	0.02	23.93	0.38
Height	0.00	0.83	-0.01	0.94
Income	-0.04	0.41	-0.17	0.82
Education	-0.05	0.57	3.30	0.01
Single Parent	-0.04	0.87	-3.58	0.26
Employed	0.17	0.29	3.69	0.11
Household Insecure	0.30	0.12	-5.52	0.04
Individual Insecure	0.35	0.12	-6.27	0.05
Child Hunger	0.67	0.02	-10.17	0.02
Disordered Eating	—	—	-0.56	0.61

vegetable consumption was lower. Education and employment were both positively related to fruit and vegetable consumption. The model for fruit and vegetable consumption included disordered eating as a covariate; regression coefficients for the other covariates were not affected by the inclusion or exclusion of disordered eating.

The results for the effects of covariates on BMI (Table 2) and obesity (Table 3) were combined with the results for the effects of covariates on disordered eating and fruit and vegetable consumption (Table 4) in order to estimate the direct and indirect effects of income and food insecurity.

These effects were first calculated for the pathway through disordered eating. For both BMI and obesity, the direct effects of income were about 10 times larger than the indirect effects through disordered eating (Table 5), indicating that income effects are not mediated through disordered eating. For BMI, the effect of household food insecurity was mostly direct, although some was through disordered eating. For obesity, both the direct and indirect effects of household food insecurity were small. For both BMI and obesity, the direct effects of both individual insecurity and child hunger were negative, while the indirect effects were positive. This means that, taking child hunger as an example, child hunger was directly associated with lower BMI and less likelihood of obesity. In contrast, child hunger was associated with higher disordered eating, which in turn was associated with higher BMI and greater likelihood of obesity.

These effects were also calculated for the pathway through fruit and vegetable consumption. All of the indirect effects through fruit and vegetable consumption were small.

DISCUSSION

The results with BMI and obesity as outcome measures of adiposity were generally similar. BMI captures the whole distribution of adiposity, while obesity focuses on those having high adiposity as compared to everyone else. As anticipated, lower income was related to higher adiposity. Unemployment

TABLE 5
Effects of Income and Food Insecurity on BMI and Obesity Directly and Indirectly through Disordered Eating and Fruit and Vegetable Consumption

	BMI		*Obesity*	
	Direct	Indirect	Direct	Indirect
Considering Indirect Effects through Disordered Eating				
Income	-0.39	-0.05	-0.20	-0.02
Household Insecure	1.93	0.34	0.04	0.14
Individual Insecure	-0.31	0.39	-0.49	0.16
Child Hunger	-1.64	0.75	-1.34	0.30
Considering Indirect Effects through Fruit and Vegetable Consumption				
Income	-0.38	-0.01	-0.20	-0.00
Household Insecure	2.20	-0.28	0.10	-0.06
Individual Insecure	-0.01	-0.31	-0.42	-0.06
Child Hunger	-1.14	-0.51	-1.24	-0.10

of the respondent was also related to higher adiposity. The effects of income on adiposity were direct, meaning that the effects of income were not mediated through disordered eating patterns or through dietary consumption as measured by fruit and vegetable consumption.

Food insecurity was related to adiposity, after controlling for income, education, single parenthood, and employment. The effect of household insecurity on BMI was large, about 2 BMI units, but was not large for obesity. Most of the effect of food insecurity on BMI was direct rather than through disordered eating. In contrast, the effect of child hunger on BMI was small, but it was large for obesity. The odds ratio for obesity was 1/2.7, meaning that the odds of being obese for those with child hunger was 2.7 times less than the odds of being obese for those food secure. The partitioning of direct and indirect effects revealed that, although the total effect of child hunger on BMI was small, the direct effect was -1.6 BMI units, while the indirect effect through disordered eating patterns was 3/4 of a BMI unit. A similar pattern for the effect of child hunger on obesity was seen. The odds ratio for the direct effect was 1/3.8 and for the indirect effect was 1.3. The pattern of effects for those with individual insecurity were similar to those with child hunger, but with smaller magnitudes.

Consumption of fruits and vegetables is indicative of the quality of the diet, and is a concern in rural areas. Morris et al. (1992) examined three factors that may limit food acquisition, contribute to food insecurity, and consequently result in poor diet quality in rural areas: limited supermarket availability, limited food item availability, and higher relative costs of foods. They found that fresh fruits and vegetables were very limited in the small and medium-size stores that are more common in rural areas. In the current study, those with food insecurity consumed fewer fruits and vegetables in a graded relationship such that those with more severe insecurity had lower consumption. However, this effect of insecurity on dietary consumption did not translate into effects on adiposity because fruit and vegetable consumption was not strongly related to either measure of adiposity.

In this same rural New York State sample, we previously found that lower income was related to increased severity of food insecurity (Kendall et al. 1995). Because of the categorical nature of the food insecurity measure, it is difficult to represent the indirect effects of income on adiposity through food insecurity. However, the effects of income on food insecurity are large, as are the effects of food insecurity on adiposity. Therefore, we conclude that at least some of the effects of lower income on higher adiposity are mediated through food insecurity. Furthermore, the results presented in this paper demonstrate that part of the effects of food insecurity on adiposity are in turn mediated through disordered eating patterns.

Those experiencing the least severe food insecurity were more likely to be overweight than those who were food secure. On the other hand, those experiencing the most severe food insecurity were less likely to be overweight than those who were food secure. This effect for those with severe food insecurity was composed of two opposing influences. Severe food insecurity acting through disordered eating patterns was related to greater likelihood of overweight, whereas severe food insecurity acting directly was related to lesser likelihood of overweight. The latter of these two influences was larger. Some in the United States have doubted that hunger and food insecurity exist because of the high rates of obesity seen in the populations most affected by hunger and food insecurity. This paper has documented the existence of this apparent paradox and has provided insight into why it occurs.

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