Food Stamp Program Participation and Obesity: Estimates from the NLSY79

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Abstract

This paper examines the relationship between Food Stamp Program (FSP) participation and adult obesity. Based on past empirical research and the human capital model of the demand for health developed by Grossman (1972), the expected relationship between FSP participation and obesity is indeterminate. This paper uses the National Longitudinal Survey of Youth (NLSY79) to examine this relationship empirically and estimates reduced form models of the demand for health with obesity and body mass index (BMI) as the outcomes of interest. A benefit of using the NLSY79 is that it is possible to include detailed controls for current income, FSP participation and long-term eligibility for and participation in the FSP, as well as individual fixed effects.

Current and long-term FSP participation are positively and significantly related to obesity and BMI for low-income women in models with individual fixed effects. The estimates suggest that benefits from the FSP do not have the same relationship to obesity and BMI as cash income or as other benefits provided by the government. Current FSP participation is associated with approximately a 9.2% increase in the predicted probability of obesity and five years of FSP participation in the previous five years is associated with approximately a 19.4% increase in the predicted probability of obesity for low-income women. The relationship between FSP participation and BMI, although statistically significant, is considerably smaller in percentage terms. Current FSP participation is associated with approximately a 0.7% increase in predicted BMI and five years of FSP participation in the previous five years is associated with approximately a 2.8% increase in predicted BMI for low-income women. Current and long-term FSP participation are not significantly related to obesity for low-income married men in models with individual fixed effects. However, long-term FSP participation is positively and significantly related to BMI. Five years of FSP participation in the previous five years is associated with approximately a 3.3% increase in predicted BMI for low-income married men.

1. INTRODUCTION

In 1998 the Food Stamp Program (FSP) provided vouchers worth $16.9 billion to participants in the program and served an average of 19.8 million people per month. During 1998, non-elderly adults over age 18 made up 39% of participants in the FSP (Mathematica 1999). The goal of the FSP and other nutrition assistance programs is to fight hunger, food insecurity, and related health problems (USDA Food and Nutrition Service 1999). One measure of health directly linked to food consumption is obesity. Obesity has become a primary public health concern in the United States, and this paper examines the relationship between FSP participation and obesity.

A large body of research has addressed the serious health consequences of obesity. Obesity increases the likelihood of heart disease, high blood pressure, cancer, and diabetes (for example: Stevens *et al.* 1998; Wolf and Colditz 1998; Allison *et al*. 1999). Allison *et al.* (1999) estimate that in the United States 300,000 premature deaths occur per year because of obesity and sedentary lifestyles. Chou *et al.* (2001) point out that "…in comparison the mortality associated with tobacco, alcohol and illegal drugs is about 400,000, 100,000 and 20,000 deaths per year respectively."[2]

A person's obesity status is influenced by current and past choices concerning food consumption and health behaviors. Relevant health behaviors include activity during work and leisure, cigarette smoking and alcohol consumption (Sobal and Stunkard 1989; Jeffery *et al.* 1991; Croft *et al.* 1992; Chou *et al.* 2001; Lakdawalla and Philipson 2001). The consequence of these choices for obesity differs across individuals and depends on personal characteristics such as age, race, ethnicity, gender, years of schooling and genetics. Participation in the FSP could have an effect on obesity if it influences any of these choices. For example, participation in the FSP might affect the quantity or quality of food consumed, which in turn could affect obesity. Previous research on the relationship between FSP participation and choices relevant to obesity is summarized below.

In this paper I use data from the National Longitudinal Survey of Youth 1979 (NLSY79) to estimate the relationship between FSP participation and obesity for a sample of low-income adults ages 20 – 40. The human capital model of the demand for health (Grossman 1972) is used to guide the empirical analyses. Ordinary least squares regression models are estimated separately for low-income women and married men that represent reduced-form models of the demand for health. Controls are included for FSP participation, current family income, a respondent's history of eligibility for and participation in the FSP and other individual and family characteristics that are expected to influence current levels of obesity and body mass index (BMI). Some of the models take advantage of the panel nature of the NLSY79 and include individual fixed effects that take into account unobserved differences across respondents that do not change over time.

2. PREVIOUS RESEARCH

A few studies address the relationship between FSP participation and weight directly. However, since this research is limited, other related areas of research can be used to help construct hypotheses about the expected relationship between FSP participation and obesity. Research on socioeconomic status and obesity is relevant since the FSP provides resources and nutrition education.[3] However, using this research to

make predictions about the relationship between FSP participation and obesity requires that resources from the FSP have the same relationship to obesity as other resources. Fortunately, this assumption can be tested because past research has examined whether FS and income have the same effect on other relevant outcomes such as food expenditures. Food choices are expected to affect obesity, therefore research on the relationship between FSP participation and nutrient intake (such as calorie consumption) also offers insight into the expected relationship between FSP participation and obesity.

2.1 *Relationship between FSP Participation and Overweight or Obesity*

I am aware of only one previous paper that examines the relationship between FSP participation and the weight of adults. Townsend *et al.* (2001) use a sample of 9,451 women and men from the 1994-1996 Continuing Study of Food Intake of Individuals (CSFII). The outcome of interest is overweight status, and men with a BMI greater than 27.8 and women with a BMI greater than 27.3 are classified as overweight. In logistic regression models that also control for current food insecurity, age, ethnicity, education, income, occupation, welfare status, household size, urbanization and lifestyle variables, they find that there is a positive and significant association between FSP participation and overweight for women, but not for men. Holding all else constant, participation in the FSP is associated with a 38% increase in the likelihood a woman is obese ($p = 0.0139$). Their analysis is limited by the cross-sectional nature of the CSFII, since the data do not contain potentially relevant variables such as an individual's history of poverty, social program participation and food insecurity.

Two previous studies have examined the relationship between FSP participation and obesity for adolescents. Using data from the NHANES III for youths aged 12 – 16, Bhattacharya and Currie (2000) examine the relationship between family resources, education and nutritional status measured by anemia, vitamin deficiency, high cholesterol and obesity. They do not find a significant relationship between FSP participation and these measures of nutritional status. However, with their data they are unable to control for a youth's history of poverty or social program participation.

Gibson (2001) examines the relationship between FSP participation and health for youths aged 12 – 18 using the NLSY97. One of the health outcomes analyzed is whether a youth is obese. Controls are included for current FSP participation, current income, a youth's poverty history, and other individual and family characteristics that are expected to influence youth obesity. Gibson finds that the relationship between FSP participation and obesity is not significant. However, she points out that the models do not control for the possible endogeneity of FSP participation and contain less than ideal measures of long-term poverty and social program participation.

As a whole this research suggests that FSP participation is positively associated with overweight for adult women but not for men, and FSP participation is not associated with obesity for adolescents. Since the research that directly addresses the relationship between FSP participation and obesity is limited, examining other related areas of research offers an opportunity to develop more solid expectations about the relationship between FSP participation and obesity.

2.2 *Relationship between Socioeconomic Status and Obesity or BMI for Adults*

There is extensive empirical research concerning the relationship between socioeconomic status (SES) and obesity or BMI. SES is most commonly assessed with income or education and less often with occupation or other measures (Sobal and Stunkard 1989). This research is relevant for constructing hypotheses about the relationship between FSP participation and obesity since the FSP provides recipients with additional financial resources and nutrition education. One important note is that past research primarily uses current SES and other current variables to explain current obesity and BMI. This may be problematic since relating current health solely to current SES and other current variables disregards prior influences on current health.

Sobal and Stunkard (1989) review 112 published studies on the relationship between SES and obesity in developed countries. From these studies Sobal and Stunkard conclude that there is a strong inverse relationship between SES and obesity for women, and an inconsistent relationship for men.[4] They argue that the inconsistency in the relationship for men is not due to differences in the measurement of SES and/or obesity across studies.

Two more recent studies have examined the possible mediating effects of behaviors related to health on the relationship between SES and adult BMI. Jeffery *et al.* (1991) use a sample of working men and women to study the effect of SES and health behaviors on obesity. They hypothesize that the inverse relationship between SES and obesity observed in previous studies is due to differences in health behaviors by SES. Their measure of SES is based on education and occupation variables. In OLS models including controls for age and marital status, SES remains a negative and significant predictor of BMI after controlling for dieting history, smoking status, exercise patterns and food intake for both men and women.[5] Jeffrey *et al.* assume that the continued significance of SES is due to problems measuring health behaviors or reverse causality from obesity to SES.

Croft *et al.* (1992) use a sample of black adults and a measure of SES also based on education and occupation status. For women but not for men, SES is a negative and significant predictor of BMI in OLS models with and without controls for exercise frequency, energy intake, cigarette smoking and alcohol intake.[6]

Two recent studies attempt to explain the increase in adult obesity in the United States and focus on income as one of the explanatory variables of interest. Lakdawalla and Philipson (2001) hypothesize that the increase in adult obesity over the last century can be explained by technological changes that have raised the cost of physical activity (because household and market work have become more sedentary) and reduced the cost of calories. They develop a theoretical model of obesity that implies that the relationship between income and obesity will have an inverted u-shape, holding the strength and strenuousness requirements of jobs constant.

Lakdawalla and Philipson test their theory empirically using data on working men and women from the 1976-1994 National Health Interview Surveys (NHIS) and the NLSY79. They model BMI as a function of occupational strength and strenuousness requirements, income and a number of other controls such as age, year, education, race/ethnicity and marital status. In estimates using the NHIS, the relationship between income and BMI has an inverted u-shape for men and a negative relationship for women. In NLSY79 models with earned income as the only income control, the same patterns

emerge.[7] In models including only working married women, the relationship between earned income and BMI is negative and the relationship between unearned income and BMI has an inverted u-shape.[8]

Chou *et al.* (2001) hypothesize that the increase in adult obesity since the 1970s can be explained by changes in the relative prices of nutritional and leisure choices. Specifically they focus on changes in the value of time, the costs of smoking and the prices of fast food meals, other restaurant meals and meals at home.

Chou *et al.* estimate reduced-form OLS models of BMI, and the probability of overweight and obesity using repeated cross-sections from the 1984-1999 Behavioral Risk Factor Surveillance System (BRFSS). In some of their empirical models they use predicted hourly wages or weekly hours of work to control for the value of time. Their controls for the cost of smoking include yearly state-level cigarette prices and indicators for the presence of anti-smoking regulations. To control for relative food prices, they use yearly state-level measures of the density of fast food restaurants, full service restaurants and the price of a meal in each type of restaurant and at home. Other controls in their models include race/ethnicity, gender, education, marital status, age and household income and state of residence indicator variables. Across all specifications, years of education and real household income are negatively and significantly related to BMI, the probability of overweight and obesity.[9]

Most of the past research supports the conclusion that obesity declines with SES for women and has an inconsistent relationship with obesity for men. Since the FSP provides financial resources and nutrition education, perhaps it might be reasonable to assume that FSP participation has a similar relationship to obesity as the one between SES and obesity.

2.3 *Relationship between FSP Participation and Food Expenditures*

It is possible to test the assumption that resources from the FSP have the same relationship to obesity as other resources by examining whether FS benefits and other resources have the same relationship to other relevant outcomes. Research on food expenditures has addressed this question directly.

Almost all of the available empirical evidence suggests that participation in the FSP increases expenditures on food. Estimates of the marginal propensity to consume food out of FS benefits generally range from .20 to .60, depending on the data set used, model specification and the use of sample weights. This literature is summarized in Devaney and Fraker (1989), Fraker (1990) and Levedahl (1991).[10]

An important issue is whether an additional dollar of FS benefits and an additional dollar of income have different effects on food expenditures. The majority of the previous research suggests that FS benefits have a larger effect on food expenditures than income. Non-experimental estimates of the marginal propensity to consume food out of other income range from .05 to .13. Estimates of the ratios of the marginal propensity to consume food (FS/income) generally range between 2 and 8 (Devaney and Fraker 1989; Fraker 1990; Levedahl 1991).[11]

A number of studies examine the effect on food expenditures of replacing FS coupons with cash. Two early studies find that there are no statistically significant effects on household food expenditures. Butler *et al.* (1985) compare the food expenditures of a sample of elderly and disabled individuals who participated in a 1980-

1981 FS cashout demonstration to a comparison group that received regular FS coupons. Devaney and Fraker (1986) examine food expenditures in Puerto Rico before and after the replacement of the Food Stamp Program in 1982 with a cash-based program called the Nutrition Assistance Program.

Fraker *et al.* (1996) analyze four FS cashout demonstrations that were conducted in the late 1980's. The demonstrations took place in Alabama (two different demonstrations), Washington and San Diego, California. They estimate each dollar of FS benefits cashed out reduces food expenditures between $0.18 and $0.28.[12]

Overall, the past research supports the conclusion that FSP participation increases expenditures on food and a dollar of FS benefits increases expenditures on food more than a dollar of other income. The implications for obesity depend on how food consumption changes as a result of increased expenditures on food.

2.4 *Relationship between FSP Participation and Diet Quality*

Research that investigates the relationship between FSP participation and the nutrient intakes of individuals or households may provide some insight into how FS benefits are used, which in turn may provide predictions about the relationship between FSP participation and obesity. However, considering studies that control for current family income and family characteristics in addition to participation in the FSP, the evidence on the relationship between participation in the FSP and nutrient intake is inconsistent.[13] Two of the most recent studies use the 1994-1996 Continuing Survey of Food Intake for Individuals (CSFII) and limit the sample to individuals with annual income less than 130% of poverty (Mathematica 2000; Wilde *et al.* 1999).[14]

Mathematica (2000) finds that FSP participation is not systematically related to the number of servings consumed from different food groups, the amount of vitamins, minerals and macronutrients consumed, adequate nutrient intake, or indices of overall dietary quality for adults. Their preferred models include controls for the dollar value of FS benefits as well as dietary knowledge and attitudes, per capita family income and a number of other personal characteristics. Other than controlling for dietary knowledge and attitudes, their analyses do not deal with the possibility of correlation across intakes by individuals or self-selection into the FSP.

Wilde *et al.* (1999) estimate a model that allows for the correlation of intakes within families and across intakes by individuals. They find that an indicator of FSP participation is positively and significantly related to the consumption of meat, added sugars and total fats and is insignificantly related to the intake of fruits, vegetables, grains and dairy products.[15]

Basiotis *et al.* (1998) examine the relationship between household participation in the FSP and the Healthy Eating Index (HEI, an indicator of overall diet quality) and its 10 component indices.[16] Their data are from the 1989-1990 CSFII, limited to low-income households with annual income less than 130% of poverty. Their models include both an indicator for household FSP participation and a variable measuring the weekly amount of household FS benefits. The FS indicator variable is negatively and significantly related to aggregate household HEI, and FS benefits are positively and significantly related to the aggregate household HEI.[17] The FS indicator variable is not significant for any of the component indices, but the amount of FS benefits is positively and significantly related to the vegetable, dairy and meat adequacy indices and the sodium moderation index.[18]

Basiotis *et al.* point out their analyses do not take into account correlations across index components for households or the possibility of self-selection into the FSP.

2.5 *Conclusions from Previous Research*

What then does previous research imply about the relationship between FSP participation and obesity or BMI? Taken as a whole the answer is unclear. The one previous study that examines the relationship between the FSP and the weight of adults suggests that FSP participation is positively and significantly associated with overweight status for women, but not men. Given the limited amount of direct research on FSP participation and obesity, related areas of research that may help develop expectations about the relationship between FSP participation and obesity were considered.

Since the FSP provides financial resources and nutrition education, perhaps a reasonable hypothesis is that it has a similar relationship to obesity as the one between SES and obesity. As mentioned above, most of the past research supports the conclusion that obesity declines with SES for women and has an inconsistent relationship with obesity for men.

However, past research indicates that FS benefits increase expenditures on food more than other income. Therefore it might be unwise to expect FS benefits to have the same effect as income or SES with respect to obesity. Research on the relationship between FSP participation and nutrient intake might offer insight into the expected relationship between FSP participation and adult obesity. Yet, the estimates of the relationship between FSP participation and nutrient intake range from both positive to negative and do not help clarify the situation. Overall, previous empirical research does not give a clear expectation about the relationship between FSP participation and obesity. A theoretical model of obesity may help provide this prediction.

3. *ANALYTICAL FRAMEWORK*

Obesity is a measure of health, and in this paper the determinants of obesity are derived from the human capital model of the demand for health (Grossman 1972). In the human capital model, consumers demand good health because it is both a consumption commodity and an investment commodity. The stock of health at time t depends on an initial health endowment, current and past investments in health and its rate of depreciation. Investments in health are the market goods and time used to produce better health. The efficiency or productivity of these investments differs across consumers. A consumer's productivity is influenced by personal characteristics such as age, race, ethnicity, gender and importantly, years of schooling.

Based on the human capital model, a person's health at age k ($Health_k$), can be expressed by the following relationship:

$$(1) \qquad Health_k = \beta_0 + \Sigma\beta_{1t}RESOURCES_t + \Sigma\beta_{2t}EDUCATION_t + \beta_3 Health_0 + \beta_4 X_k + \varepsilon_t$$

where t = time and Σ is the summation from $t = 0$ to $t = k$. $RESOURCES_k$ is a vector of variables measuring resources available at time k; $EDUCATION_k$ is a vector of variables that represent the stock of education at time k, and controls for differences in the health production technology; X_k is a vector of other variables that may affect the productivity

of health inputs (such as age, race/ethnicity, occupation, number of children and gender) and ε is an error term that is assumed to be uncorrelated with the other right hand side variables in the model.[19]

Equation (1) is a demand function for health, which in general depends on prices (current and past), lifetime income, parameters of the health production function (i.e., technology), endowed health and preferences. Most of these factors are represented in equation (1), but noticeably missing are prices – for example, the price of food. To account for these omitted factors, the models that are estimated in this paper include time-trend variables and a variable for the number of hours a respondent works per week. This specification is justified based on results from Chou *et al.* (2001).

If better health and the pleasure of eating both have value to the consumer, the theoretical relationship between income (or FS benefits) and obesity is not clear. Possible ways that people could improve the experience of eating is by consuming more food or substituting into higher calorie food that tastes (or smells or looks, etc.) better. If individuals respond to an increase in income in either of these ways, better health (lower obesity) and more pleasurable eating experiences may be conflicting goals. For those at or above normal weight, weight could rise with income (or FS benefits) if the value of pleasurable eating exceeds the (absolute) value of increased weight.

Assuming increased calorie consumption enhances the pleasure of eating, a person would like to have both better health and larger calorie consumption as income rises. This is possible if the number of calories expended rises faster with income than the number of calories consumed. Past research suggests that calories expended at work tend to be lower and calories expended outside of work tend to be higher for those with higher incomes (Jeffrey *et al.* 1991; Croft *et al.* 1992; Lakdawalla and Philipson 2001).[20] Given this finding the expected relationship between income and obesity remains unclear and therefore the expected relationship between FSP participation and obesity will also be indeterminate.[21]

In the human capital model of health, individuals with higher education are able to obtain a larger amount of health from a given amount of input. This "productive efficiency" leads those with higher education to have a greater demand for health because it increases the marginal benefit of a given amount of health investment. It has also been proposed that education improves health because of "allocative efficiency." The hypothesis is that education increases knowledge about the relationship between inputs and health and leads to the selection of a better mix of inputs (Grossman and Kaestner (1997) summarize this literature).

In addition to FS coupons, the FSP also provides participants with nutrition education.[22] Nutrition education provided by the FSP could reduce the obesity of participants if it leads to healthier preparation or healthier food choices by participants. Even if FSP participation does not change participants' preparation methods or diets, participation in the FSP could reduce obesity if it results in the adoption of other "healthy lifestyle" prescriptions.

Theoretically the education provided by the FSP should be associated with reduced obesity. Theoretically the resources provided by the FSP could lead to either an increase or decrease in the level of obesity due to the potentially competing influences of better health and the enjoyment of eating. Therefore, as a whole this theoretical framework does not provide a clear prediction about the relationship between FSP

participation and obesity. However, it does suggest a model that can be used to examine empirically this relationship.

4. *EMPIRICAL ANALYSES*

The empirical analyses in this paper use data from the NLSY79. The NLSY79 oversamples black, Hispanic and economically disadvantaged non-black non-Hispanic individuals. The survey was conducted annually between 1979 and 1994 and then switched to a biannual schedule. In 1979 the sample contained 12,686 respondents ages 14 to 22. The empirical analyses in this paper use the data through the 1996 wave of the survey. The data are arranged as a panel so that a separate observation for each individual is included in the data each year the individual participates in the survey and meets other data requirements. Therefore there are multiple observations on individuals who participate in the survey in multiple years and the unit of analysis is a person-year. After exclusions the sample ranges in age from 20 to 40.

Ideally I would like to estimate models of the form of equation (1), where current obesity or BMI is a function of past and current resources and education, the respondent's initial health endowment and other variables that affect the productivity of health inputs. The NLSY79 contains a number of variables that allow an approximation of this model.

The goal of this paper is to determine the relationship between FSP participation and obesity for those who are eligible for the FSP. For the purposes of creating a sample that misses few individuals who are eligible for the FSP, respondents are included in the sample in years where their total family income-to-needs ratio is less than or equal to two.[23] These models are run separately for women and married men.[24]

4.1 *Outcome Variables*

Respondents were asked to report their current weight in the 1981, 1982, 1985, 1986, 1988-1990, 1992-1994 and 1996 interviews.[25] Self-reported height information was collected in 1981, 1982 and 1985. An algorithm developed in Averett and Korenman (1996) is used to deal with missing height information and individuals whose reported height shrinks with age.[26] The outcomes of interest in this paper are BMI and obesity. BMI is defined as weight in kilograms divided by height in meters squared. Height from 1985, when respondents were between 20 and 28, is used in the BMI calculation for the years 1985 and later. In these analyses, a person is categorized as obese if his or her BMI is greater than or equal to 30 (U.S. National Institutes of Health 1998).[27]

4.2 *Explanatory Variables*

Values of variables from the same survey year as the outcome variables are referred to as "current" values of these variables. Following Grossman's model, control variables in the empirical analyses measure either family resources, education or other personal or family characteristics that are expected to influence obesity and BMI. Family resource measures include FSP and AFDC participation, family income, family size and marital status.

The empirical analyses also include controls for the education and ability of the respondents such as the highest grade completed, highest grade completed by parents, percentile on the Armed Forces Qualifying Test (AFQT) and FSP participation. Notice

that FSP participation has been mentioned as a measure of both resources and education. Since the empirical models estimated in this paper are reduced-form models, it is not possible to separate out the resource and education effects of variables that may exert influence through both pathways. [28]

Other controls include hours worked, age, age-squared, race, ethnicity, urban residence, region, occupation and pregnancy status.[29] Additionally whether a respondent is currently in college is included as a control because college students are categorically ineligible for the FSP. The models also include time-trends, specifically the number of years between the year of the observation and 1985 and the square of this number.[30] Time-invariant variables and the age and age-squared terms are dropped from models that include individual fixed effects.[31] The age and age-squared terms are dropped because they cannot be separately identified from the time and time-squared variables.[32] The variables created to measure income, FSP eligibility and FSP participation require a more detailed explanation.

Income

For each year of the survey the NLSY79 collects information on the total family income of a respondent's family in the calendar year preceding the survey year (referred to as "current" income for the survey year). This variable includes income from possible sources such as wages, spouse's wages, income from a business and income from social programs such as AFDC, Food Stamps and other public assistance (Center for Human Resources Research 1999). This variable forms the basis for the income measures used in this paper.[33] A difficulty with relying on this variable to measure income is that it is missing if any of the components are missing.[34]

The total family income variable is used as a starting point for a number of different income variables: income excluding the amount of FS benefits, income excluding the amount of AFDC benefits and income excluding the amount of both FS and AFDC benefits.

An additional complication with the total family income variable arises for respondents who were dependent at the time of the interviews. From 1979-1986 the parents of dependent respondents were asked for the amount of their total family income in the previous calendar year. However they were not specifically asked about family participation in the FSP. Instead, parents of respondents were asked whether they participated in *any* government social programs. For the 1987 survey and beyond, all respondents were asked the same set of income questions regardless of their dependent status. Since it is not possible to treat dependents consistently over time in the NLSY79, a respondent is not included in the sample in any year in which he or she is dependent.

Eligibility for Food Stamps

Families are eligible for the FSP if total family income falls below limits on gross and net income. Families must also meet additional limits on assets. The gross income limits correspond to approximately 1.3 times the poverty guidelines appropriate to the size of the family (USDA 2001).[35] The government sets maximum monthly FS benefits. The amount of benefits a family receives is the difference between the maximum monthly allotment and three-tenths of net monthly household income. Larger (smaller) AFDC benefits result in smaller (larger) FS benefits. In the analyses, a respondent is

defined as currently eligible for the FSP in survey years where total family income net of FS benefits (hereafter referred to as FS eligibility income) corresponds to an income-to-needs ratio that is less than 1.3.[36] A respondent's FS eligibility income-to-needs ratio is calculated by dividing the FS eligibility income of the respondent by the poverty guideline appropriate to the respondent's family size.

An important question is how well this definition captures actual eligibility for the FSP. The definition classifies 61% of woman-year observations and 44% of married man-year observations as income-eligible for the FSP. About 88% of woman-year observations and 79% of married man-year observations that are FSP participants are income-eligible for the FSP.[37] Those defined as eligible non-participants are 47.5% of the woman-year observations and 66.5% of the married man-year observations in the sample. Unfortunately, it is not possible to determine what percentage of those person-years defined as eligible non-participants are truly eligible for the FSP.

Eligibility for the FSP also includes asset limitations. Households may have $2000 in countable assets, such as a bank account. For most vehicles, the fair market value over $4650 is counted toward assets. The assets of those who receive SSI or benefits under AFDC are not counted (USDA 2001).

Two alternative measures of eligibility for the FSP are also considered. The first alternative definition starts with the eligibility income-to-needs definition and adds the requirement that a respondent's family may not have more than $2000 in assets, ignoring the value of vehicles. The second alternative definition adds the requirement that the value of a family's vehicle above $4650 is included in the value of family assets. Respondents who receive SSI or AFDC are exempted from the asset requirements. Using the first alternative definition, 87% of the woman-year observations and 78% of the married man-year observations that are FSP participants are eligible for the FSP. Using the second alternative definition, 86% of the woman-year observations and 72% of the married man-year observations that are FSP participants are eligible for the FSP.[38] The information on assets and car values is available for the interview years 1985-1990, 1992-1994 and 1996. As will be discussed below, the variables that measure long-term income and program participation use five previous years of data. Once the long-term variables are created, the use of the alternative definitions of eligibility leave only the years 1990 and later as "current" years in the sample. Due to the smaller sample size available with the alternative definitions of eligibility and the similarities in the percentage of non-eligible participants across all definitions, the definition of eligibility based solely on the eligibility income-to-needs ratio is used in all of the empirical analyses.

Food Stamp and AFDC Receipt

The empirical models of obesity and BMI include controls for current FSP participation. Two main specifications of FSP participation are used in the empirical analyses. The first is an indicator variable for FSP participation in the previous calendar year. The second is a continuous variable measuring the amount of FS benefits a household received in the previous calendar year. These variables are referred to as measures of "current" FSP participation. Some of the empirical models also include equivalent variables for AFDC participation.

Long-Term Eligibility and Long-Term FS Receipt

Grossman's model suggests that a respondent's history of resources belongs in an empirical model explaining current obesity. Variables are included in the empirical models to measure a respondent's average level of resources over the previous five survey years (hereafter referred to as the "previous five years") and the variance in that level of resources.[39]

The average long-term level of resources of a respondent is approximated with the average of the respondent's eligibility income-to-needs ratios in the previous five years. There are two separate terms included in the regression models, one is the average for respondents with data in each of the five previous years with a value of zero otherwise; the other is the average for respondents with fewer than five years of data in the previous five years with a value of zero otherwise.

For respondents with observations in each of the five previous years, the variance of long-term resources is approximated by the number of years in the previous five a respondent's family was eligible for the FSP. This variable is set equal to zero if a respondent is missing data on eligibility in any of these years. An additional indicator variable for fewer than five years of eligibility income in the previous five years is also included in the regressions.[40]

A variable was created to measure the number of years a respondent participated in the FSP in the five previous years. This variable is also set equal to zero if a respondent is missing data on FSP participation in any of these years. The models also include two indicator variables for missing long-term FS receipt. One indicator variable is equal to one if long-term FSP participation is missing because the respondent was a dependent in the previous five years and zero otherwise. The other indicator variable is equal to one if long-term FSP participation is missing for other reasons (such as non-response) and zero otherwise.[41]

5. *ANALYTICAL ISSUES*

A concern in trying to estimate the relationship between FSP participation and obesity is that FSP participation is endogenous. If the cause of the endogeneity is due to the omission of variables related to both FSP participation and obesity, the inclusion of individual fixed effects may generate unbiased estimates of the relationship between FSP participation and obesity. If instead the endogeneity of FSP participation is due to reverse causality from obesity to FSP participation, fixed effects are not sufficient and a solution such as instrumental variables for FSP participation is needed.

FS recipients may differ from non-recipients even when individuals with the same measurable characteristics are compared. For example, unmeasured genetic characteristics may be related to the likelihood that an individual receives FS as well as the obesity status of the individual. If unobserved differences between respondents are correlated with both obesity and FS receipt, the estimated effects of the FSP on obesity will be biased. If the unobserved characteristics of the respondents do not vary over time, one solution to the omitted variable bias problem is a fixed effect model. It is possible to use the panel nature of the NLSY79 to create individual fixed effects, and they are included in some of the empirical models.

Even in models that include individual fixed effects, participation in the FSP may still be endogenous if unobserved characteristics of individuals related to obesity vary over time or if there is reverse causality between obesity and FSP participation. A

common way of dealing with this type of endogeneity is to use instrumental variables for FSP participation.[42] The geo-coded NLSY79 data provide the opportunity to use variables that vary across locations as instruments for FS receipt.

In the case of panel data an acceptable instrument needs to vary both within year and across time. Currie and Cole (1993) instrument for participation in the AFDC program in the years between 1979 and 1988 with yearly measures of the generosity of state welfare programs. For example they use a state's yearly maximum AFDC benefit, needs standard for a family of four, average AFDC, FSP and Medicaid payments per recipient, whether pregnant women without other children are eligible for AFDC and the Medicaid income cutoff.

Following Currie and Cole (1993), I also explored the possibility of using yearly measures of the generosity of state welfare programs as instruments for current and long-term FSP participation. The variables used as instruments are the yearly average of a state's monthly AFDC payments, monthly AFDC maximum grant for a family of four, monthly AFDC need standard for a family of four, FS benefits per recipient, Medicaid payments per recipient and the unemployment rate in the respondent's county of residence.[43] Specifically the variables used as instruments for FSP participation and long-term FSP participation for an observation for a given survey year are the value of each of the available instruments for the previous year and the average of the values for each instrument over the 2nd through the 6th previous calendar years.

A concern when using instrumental variables is the possibility of weak instruments (Bound, Jaeger and Baker 1995).[44] Bound, Jaeger and Baker propose two statistics that can be used as indicators of the quality of instrumental variable estimates. The first is the partial R-squared on the instruments in the first stage. The second is the F-statistic on the test of whether the coefficients on the instruments in the first stage are jointly equal to zero. A rule of thumb is that this F-statistic should be equal to 10 or more in order to avoid the problems of weak instruments (Staiger and Stock 1997)

I started with the assumption that current FSP participation and long-term FSP participation were the only variables for which instruments were needed. If the instruments had proved successful then the endogeneity of other variables would have been considered. Regardless of the exact specification of the first stage of the instrumental variables estimation, the partial R-squared averaged around .04 and the F-statistic on the test of joint significance was never greater than 10 (and usually around a value of 5).[45] Given the weakness of the instruments, the IV results are not presented in the paper.[46]

6. *SAMPLE CHARACTERISTICS*

Means and standard deviations for all of the variables used in the regressions are presented separately for woman-year and married-man-year observations in Table 1. Since the NLSY79 is a panel data set, it is possible to see how the weight and obesity status of respondents changes over the panel. The following calculations are based on respondents that enter the sample in at least one survey year and include only survey years in which a respondent's family income-to-needs ratio is less than two and where other data requirements are met. The purpose of these restrictions is to get an idea of the variation in obesity, BMI and FSP participation that can be used to estimate the empirical models.

Of women (married men) in the sample, 74.7% (78.1%) are never obese in the years they are in the sample, 16.5% (9.9%) change obesity status over the years they are in the sample and 8.8% (12.0%) are obese every year they are in the sample. Of those who flipped obesity status, 66% (74%) flipped once and the remainder flipped obesity status more than once.

When a woman (married man) in the sample *becomes obese* the average change in BMI is 4.9 (3.4) points and the average change in weight is 28 (22) pounds.[47] When a woman (married man) in the sample *becomes non-obese* the average change in BMI is -4.1 (-3.0) points and the average change in weight is - 22 (-17) pounds.

Equivalent figures can be calculated for FSP participation. Of women (married men) in the sample, 59.5% (73.6%) never receive FS in the years they are in the sample, 31.0% (20.8%) change FS status over the years they are in the sample and 9.5% (6.6%) receive FS every year they are in the sample.

7. *RESULTS*

Tables 2 – 11 contain OLS regressions of the probability of obesity and BMI.[48] For both outcomes there are four main specifications of current and past resources and FSP participation. Models for each specification are estimated with and without the inclusion of individual fixed effects.

The first main specification for current and past resources includes controls for current FS eligibility income, current FSP participation (as an indicator variable), long-term income-to-needs, long-term FSP eligibility and long-term FSP participation (models (1) and (2)). If FSP participation is significantly related to obesity, a key question is whether FS resources and other family resources have different relationships to obesity. To try to determine whether this is the case, the second main specification for current and past resources includes *total* family income (*including* the amount of FS benefits) rather than FS eligibility income (models (3) and (4)). The third main specification for current and past resources tests whether there is a difference in the dose-response relationship to obesity of FS resources and other resources. In these models a variable for the current amount of FS benefits replaces the indicator for current FSP participation (models (6) and (7)). Finally, models (7) and (8) remove all current indicators of resources and FSP participation to determine whether the coefficients on long-term eligibility and FSP participation change with their exclusion.

7.1 *Women*

7.1.1 *Obesity*

Tables 2 and 3 present OLS regressions of obesity for models (1) – (8) for women. The odd numbered models in Tables 2 and 3 do not include individual fixed effects. The results of these models suggest that FS eligibility income and FSP participation are positively and significantly related to obesity, that the long-term income-to-needs ratio is negatively and significantly related to obesity, and that long-term FSP participation is positively and significantly related to obesity. The even numbered models in these tables include individual fixed effects. The results of these models are discussed in detail below, and they suggest that models of obesity without individual fixed effects are subject to omitted variable bias.

In model (2), current FSP participation and long-term FSP participation are positively and significantly related to obesity. The coefficients on variables measuring current FS eligibility income, long-term income-to-needs and long-term eligibility variables are not significantly different from zero.

Current participation in the FSP is related to a 2.00 percentage point increase in the predicted probability of obesity and each year of FSP participation in the previous five is related to a 0.85 percentage point increase in the predicted probability of obesity. The average FS benefit for women in the sample is $913 and it is $2393 for FSP participants (unweighted). By way of comparison, a one standard deviation increase in FS eligibility income of $9470 increases the predicted probability of obesity by .26 percentage points. This strongly suggests that FS benefits and other resources do not have the same relationship to obesity.

The estimates from model (4) can provide further insight this issue. This model replaces FS eligibility income with total family income. If FSP participation is not significant in this model, then the relationship of FS resources and other resources to obesity can not be distinguished statistically from each other. In model (4) the coefficient on FSP participation falls slightly (to 0.0196) but it is still significantly different from zero. This provides further support for the conclusion that FS resources and other income have a different relationship to obesity. The size of the coefficient on the long-term FSP participation variable hardly changes from model (2) to (4). The coefficients on current income, long-term income to needs and long-term eligibility remain insignificant.

Model (6) includes separate controls for the amount of eligibility income and the amount of FS benefits. The coefficient on the amount of FS benefits is nearly significant at the ten percent level and is twenty-four times as large as the coefficient on FS eligibility income. The coefficient on long-term FSP participation is still positive and significant. As in the other models with individual fixed effects, the coefficients on long-term income-to-needs and long-term eligibility are insignificant.

Model (8) excludes current eligibility and FSP participation. When these variables are removed, the size and significance of the coefficients on the other variables in the model hardly change. Long-term FSP participation is still positively and significantly related to obesity. Also, the coefficients on long-term income-to-needs and long-term eligibility are insignificant.

FSP participation is positively and significantly related to obesity in models (1) – (8). A question that remains to be explored is whether social program participation in general, instead of FSP participation in particular, is driving these results. Models (9) – (12) examine this possibility using AFDC participation and benefits.[49] These models include four alternative specifications of current and past resources.

The first alternative specification of current and past resources includes total family income without AFDC benefits, an indicator for AFDC participation and the set of long-term and other control variables used in model (2) (model (9)). The second alternative specification of current and past resources is the same as the first but replaces long-term FSP participation with long-term AFDC participation (model (10)). The third alternative specification of current and past resources includes total family income without FS or AFDC benefits, indicators for current FSP and AFDC participation and the set of long-term and other control variables used in model (2) (model (11)). The final alternative specification of current and past resources is the same as the third except long-

term AFDC receipt variables are also included (model (12)). These results are presented in Table 4.

The estimates in Table 4 offer support for the hypothesis that FSP participation in particular is responsible for the significance of the relationship between FSP participation and obesity. In model (9) neither AFDC participation nor income without AFDC benefits are significantly related to obesity. The coefficient on long-term FSP participation has roughly the same size and significance as in earlier models. Long-term income-to-needs and long-term eligibility are still not significantly related to obesity.

Model (10) replaces long-term FSP participation with long-term AFDC participation. This variable is not significantly related to obesity, suggesting that the significance of long-term FSP participation in earlier models is not simply due to long-term participation in government programs. Current AFDC participation and income remain insignificant.

Model (11) includes indicators for FSP and AFDC participation, and also includes total family income excluding benefits from both of these programs. FSP participation is positively and significantly related to obesity. AFDC participation and income without program benefits are not significantly related to obesity. The size and significance of the coefficients of the current FSP participation and long-term FSP participation variables are similar to the results of previous models. The F-statistic for the test of the hypothesis that the coefficient on FSP participation is equal to the coefficient on AFDC participation is 2.43 (prob > F =0.119). It is nearly possible to reject the hypothesis that these coefficients are equal. The average FS benefit is $2395 per year and the average AFDC benefits is $3095 per year for women in the sample who are FSP participants. This suggests that even if the coefficients on the indicators for participation are the same, the relationship to obesity per dollar of benefits is larger for the FSP.

Model (12) adds an indicator for long-term AFDC participation. Neither current nor long-term AFDC participation is significantly related to obesity. Additionally, current and long-term FSP participation are positively and significantly related to obesity (again with coefficients that are slightly larger than earlier models). The F-statistic is 2.53 (prob > F = .111) for the test of the hypothesis that the coefficients on FSP participation and AFDC participation are equal and is 2.29 (prob > F = .130) for the test of the hypothesis that the coefficients on long-term FSP participation and long-term AFDC participation are equal. Again it is nearly possible to reject the hypothesis that the coefficients on the pairs of variables are equal. On average, long-term FSP participants receive a smaller amount of benefits from the FSP than from AFDC.

FSP participation is positively and significantly related to obesity in models (1) – (12). The models attempt to test whether FSP participation has the same relationship to obesity as cash income or other income from government sources. The results provide strong support for the conclusion that FS benefits and cash resources have a different relationship to obesity and more qualified support for the hypothesis that benefits from FS and AFDC have a different relationship to obesity.

From a policy point of view, a key question is the magnitude of the relationship between FSP participation and obesity and how it compares to the magnitude of other coefficients in the models. Using the estimates from model (2), a woman who is not a current or former FSP participant and has values of the remainder of characteristics equal to sample averages (unweighted) has a predicted probability of obesity of 21.8 percent.

Holding all else constant, participation in the FSP increases the predicted probability of obesity by 2.0 percentage points, or by 9.2 percent. Participation in the FSP for each of the five previous years increases the predicted probability of obesity by 4.25 percentage points, or by 19.4 percent.

Again using the estimates from model (2), large changes in the probability of obesity are also predicted for women who are married (+ 2.3 percentage points), have a larger family size (+ 1.4 percentage point per additional family member) or live in the South (- 6.6 percentage points) (these coefficients are not shown in Table 2). Each additional calendar year adds 1.7 percentage points to the predicted probability of obesity (this coefficient captures the effect of increasing age as well as the increasing rate of obesity over time).[50]

7.1.2 *BMI*

Tables 5 and 6 present OLS regressions of BMI for models (1) – (8) for women. The odd numbered models in Tables 5 and 6 do not include individual fixed effects. As in the models for obesity, the comparison of models with and without individual fixed effects suggests that there is considerable omitted variable bias in the former. The results of the models with fixed effects are discussed below.

In model (2), current FS eligibility income and current and past FSP participation are positively and significantly related to BMI. Holding all else constant, current FSP participation is related to a .186 point increase in predicted BMI and each year of FSP participation in the previous five is associated with a .146 point increase in BMI. Additionally, the indicator variables for missing values of long-term FSP participation are positively and significantly related to BMI. An interesting result is that long-term eligibility for the FSP is negatively and significantly related to BMI. Holding all else constant, an additional year of eligibility in the previous five years is associated with a .076 point decrease in BMI. Given the coefficients from model (2), a one standard deviation increase in eligibility income of $9470 increases predicted BMI by .084 points. As is the case with obesity, this suggests that FS benefits and other income have a different relationship to BMI.

When total family income is included in model (4), FSP participation remains positively and significantly related to BMI. This provides additional support for the hypothesis that FS benefits and other resources have a different relationship to BMI. The other coefficients in the model have signs and significance that are very close to the results of model (2).

Model (6) tests the dose-response relationship of FS benefits and other income to BMI. Both coefficients are significant and the coefficient on the amount of FS benefits is significantly larger than the coefficient on FS eligibility income ($F = 2.71$, prob > F = 0.099). The coefficients on other variables are similar to the results in previous models. Current income and FSP participation are removed from model (8). The coefficients on the other variables in the model hardly change, suggesting the model is not misspecified with the inclusion of variables measuring current resources.

As with obesity, a question of interest is whether the significance of the relationship between FSP participation and BMI in models (1) – (8) is a consequence of a relationship between BMI and social program participation in general. The results of models (9) – (12) for BMI are presented in Table 7. The results provide strong support

for the conclusion that FS benefits and cash resources have a different relationship to BMI and more qualified support for the argument that benefits from FS and AFDC have a different relationship to BMI.[51]

The impact of FSP participation on predicted BMI is smaller in percentage terms than the relationship between FSP participation and the predicted probability of obesity. Using the estimates from model (2) for BMI, a woman who is not a current or former FSP participant and has values of the remainder of characteristics equal to the sample averages has a predicted BMI of 26.2. Holding all else constant, participation in the FSP increases the predicted BMI by .185 points, or by 0.70 percent.[52] Participation in the FSP for each of the five previous years increases the predicted BMI by .725 points, or by 2.76 percent.[53]

By way of comparison using the estimates from model (2), large changes in BMI are predicted for women who are married (+ .364 points), or live in the South (- .700 points) (these coefficients are not shown in Table 5). Each additional year calendar year adds .369 points to predicted BMI.[54]

7.2 *Married Men*

Models (1) – (8) are estimated for married men for both obesity and BMI. The results of OLS regressions for obesity are in Tables 8 and 9 and the results for BMI are in Tables 10 and 11. Current and long-term FSP participation are not significantly related to obesity in any of the models that include individual fixed effects. Neither are any of the other variables that measure resources, with the exception of a negative and significant coefficient on some of the indicators for missing long-term FSP participation.

The results change slightly when BMI is the outcome of interest. Current income, current FSP participation, long-term income-to-needs and long-term eligibility are not significantly related to BMI in models with individual fixed effects regardless of the specification of current and previous resources. However long-term FSP participation is positively and significantly related to BMI in all of the models with individual fixed effects, and the coefficient estimates range from .172 to .179.

Using the results from model (2), a married man who is not a current or former FSP participant with the values of the remainder of characteristics equal to the average values in the sample has a predicted BMI of 26.8. Participation in the FSP for each of the five previous years increases the predicted BMI by .895 points, or by 3.3 percent.[55] The only other variables that are significant is the indicator for currently in college (+.481 points) and the calendar year (+ .299 points per year) (These coefficients are not shown in Table 10).[56]

8. CONCLUSIONS

In the estimates presented in this paper, current and long-term FSP participation are positively and significantly related to obesity and BMI for low-income women and long-term FSP participation is positively and significantly related to BMI for low-income married men. These findings hold under a variety of specifications.

The inclusion of individual fixed effects in the empirical analyses take into account unobserved characteristics of individuals that do not vary over time. However, the difficulty of finding acceptable instruments for FSP participation means that these

results may be biased if there are unobserved characteristics of individuals that vary over time or reverse causality from obesity to FSP participation.

Additionally, the models in this paper do not control explicitly for food insecurity and some previous research finds a positive relationship between food insecurity and weight. Therefore, excluding food insecurity may confound the relationship between FSP participation and obesity. Using the 1994-1996 CSFII, Townsend et al. (2001) find that food insecurity is positively and significantly associated with overweight for women. They propose that variation in food intake, where periods of deprivation are followed by periods of adequate food supply explains this finding. They link this variation in food intake to the possibility of overweight using past research that shows a positive association between binge eating and overweight and research that links food deprivation with binge eating.

However, Townsend *et al.* find that only mildly food insecure women have a higher probability of overweight than do food secure women. A household is considered mildly food insecure if a respondent says that the statement, "enough but not always the kinds of foods we want to eat," best describes the food eaten in his or her household in the last three months. The two more severe categories of food insecurity that involve hunger ("sometimes not enough to eat" or "often not enough to eat") are not significantly related to overweight. Therefore their conclusion that "these results suggest that overweight is related to involuntary, temporary food restriction" may be questionable since only mild food insecurity is significantly related to overweight and mild food insecurity does not involve hunger or lack of food.

It is possible that the significance of mild food insecurity in models of overweight found by Townsend *et al.* could be driven by the omission of other relevant variables, as they do not include measures of long-term resources or social program participation in their models. Ideally it would be useful to control for food insecurity in models of weight. However, the severity of this omission in a model of obesity may be minimal since the strength of the food insecurity and weight relationship is questionable. More research is needed on the variation in food intake with food insecurity, as well as research that attempts to link the fluctuation in intake to outcomes such as overweight and obesity.

Assuming the relationship between FSP participation and obesity is estimated correctly, what policies to reduce obesity are suggested by the results? The answer depends on the mechanism for the relationship between FSP participation and obesity. The analyses in this paper assume that the human capital model of obesity can be used to explain the relationship. However, the only other paper that examines the relationship between FSP participation and adult weight puts forward an alternative mechanism.

Townsend *et al.* (2001) hypothesize that variation in food consumption over the FS benefit cycle may explain their finding that FSP participation is positively and significantly related to overweight for women. FS benefits are provided monthly and Townsend *et al.* speculate that families may overeat when benefits first arrive, and face periods of deprivation when benefits near depletion.

Wilde and Ranney (2000) examine the variation in food energy intake over the monthly benefit cycle of FSP participants. They show that there is a large spike in food expenditures immediately after monthly benefits are received and they examine whether there are corresponding fluctuations in food energy intake. They find that the pattern of food energy intake differs for households participating in the FSP depending on whether

households shop for food frequently (more than one major shopping trip per month) or infrequently (one major shopping trip per month). They use data from the 1989-1991 CSFII, and find that mean food energy intake for frequent food shoppers remains steady during the four weeks of the FS month (at around 80% of RDA). In contrast, they find that the mean food energy intake for infrequent shoppers falls from 83% of RDA in the first week after benefits are received to 73.4% of RDA in the fourth week after benefits are received (a significant difference). These results do not provide evidence of extreme levels of calorie consumption at the household level over the monthly benefit cycle. However, Wilde and Ranney point out that it is likely that there is underreporting of intake in this sample. More research is needed to establish the extent of the FS intake cycle and whether the variation in intake results in increasing weight.

Since the intake cycling theory for the relationship between FSP participation and weight is not well supported, my policy prescriptions are based on the human capital model of obesity. In this model the relationship between FS and obesity is expected to work through the resources and education provided by the FSP. Therefore education and changes in restrictions on the use of FS benefits, the mode of delivery and the amount of FS benefits are available as possible policy tools.

The large increase in the predicted probability of obesity for low-income women who are participants in the FSP suggests the need for nutrition education or other education programs that aim to reduce the obesity of FSP participants, regardless of whether obesity is caused by or simply correlated with FSP participation.

There is no requirement under the regulations of the FSP that states provide nutrition education. However, as mentioned previously, individual states are allowed to develop their own Nutrition Education Plans (NEPs). Forty-nine states had approved NEPs as of 1999 (USDA 1999). Health Systems Research (2000) examined 50 implementing agencies in 38 states, and found that weight management or weight reduction is a specific behavioral objective in the NEPs of 10 of them. A question that remains to be addressed is how well these and other programs are able to achieve their goals. To date the evaluation of nutrition education programs have been extremely limited (USDA 1999). Evaluations of these programs are essential in order to know whether the use of targeted education programs is effective in reducing obesity or whether alternative policy solutions for reducing the obesity of FSP participants need to be considered.

Policies that loosen or tighten existing restrictions on the use of FS benefits may be able to reduce the obesity of participants. Currently, FS benefits can not be used to purchase ready-to-eat meals. The food choices of FSP participants could possibly be improved if FSP participants were allowed to purchase "healthy" ready-to-eat meals or use their benefits to purchase meals through weight control programs. Additionally, restrictions on "unhealthy" foods could be considered as a way to improve the food choices of FSP participants.

Other possible policies aimed at reducing obesity could change the mode of delivery or the amount of FS benefits. In fixed-effects models, income is not significantly related to obesity. This finding offers an argument in favor of cashing-out FS benefits. Additionally, the estimates provide some support for the conclusion that reducing the amount of FS benefits would reduce obesity. However, obesity is not a problem for all FSP participants. In the NLSY79 sample used in the empirical analyses,

29.6% of the woman-year observations that are current FSP participants are obese. Cutting the benefits of all participants in hopes of a reduction in obesity would be very drastic. A reduction in benefits may increase other problems for the participant or members of his or her family. Therefore, increasing nutrition education or access to healthy food seem like the best policy tools to reduce the obesity of FSP participants.

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Table 1: Means and Standard Deviations of Characteristics of Women and Married Men in the NLSY79 Pooled Sample[a]

	Woman-Years		Married-Man-Years	
Variables	Mean	Std. Dev.	Mean	Std. Dev
Health[b]*:*				
Obese	.235	.424	.221	.415
Overweight	.261	.439	.408	.492
Underweight	.027	.162	.006	.08
BMI	26.5	6.26	27.0	4.89
Current Resources[c]*:*				
Total Family Income - $	15026	9066	20491	8878
FS Eligibility Income - $	14112	9470	20080	9126
Total Family Income w/o AFDC Benefits - $	13770	9771	20181	9123
Total Family Income w/o FS or AFDC Benefits - $	12857	10352	19771	9444
Eligibility Income-to-Needs Ratio	.986	.58	1.27	.51
FSP Participant	.382	.486	.20	.40
FS Benefit Amount - $	913	1475	410	1070
AFDC Participant	.258	.437	.068	.252
AFDC Benefit Amount - $	1255	2622	312	1442
Long-term Resources [d]				
LT Income-to-Needs Ratio – 1	.746	1.32	.956	1.28
LT Income-to-Needs Ratio – 2	.689	1.6	.778	1.09
# Years of FS Eligibility in Prev. 5[I]	1.44	1.97	.914	1.56
LT FS Eligibility Missing	.476	.499	.483	.50
# Years of FSP Participation in Prev. 5[I]	.937	1.73	.413	1.11
LT FSP Participation Missing – 1	.224	.417	.237	.425
LT FSP Participation Missing – 2	.298	.457	.306	.461
# Years of AFDC Participation in Prev. 5[I]	.621	1.45	.129	.597
LT AFDC Participation Missing	.522	.50	.542	.498
Other Characteristics:				
Hours Worked per Week	24.1	19.6	38.1	18.3
Age in years - 20	9.27	4.15	9.44	3.96
(Age in years - 20) squared	103.2	80.6	104.8	78.7
Black non-Hispanic	.352	.478	.23	.421
Hispanic	.192	.394	.246	.431
Married	.481	.50	1	0
Family Size	3.33	1.57	3.92	1.4
Pregnant at Interview	.056	.229	-	-

Table continues on next page

Table 1 - continued: Means and Standard Deviations of Characteristics of Women and Married Men in the NLSY79 Pooled Sample[a]

	Woman-Years[a]		Married-Man-Years[a]	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
Other Characteristics – continued:				
Highest Grade Completed - 12 [I]	-.126	1.88	-.306	2.05
Highest Grade Completed Missing	.227	.419	.221	.415
Currently in College [I]	.064	.244	.038	.191
College Status Missing	.003	.056	.002	.041
AFQT[I]	26.2	23.5	27.6	25.9
AFQT Missing	.041	.199	.074	.261
Mother's Highest Grade Completed[I]	9.17	4.05	8.84	4.34
Mother's Highest Grade Completed Missing	.075	.263	.093	.29
Father's Highest Grade Completed[I]	7.70	5.28	8.00	4.99
Father's Highest Grade Completed Missing	.206	.404	.15	.357
North-Central[I]	.242	.428	.224	.417
South[I]	.417	.493	.428	.495
West[I]	.199	.399	.206	.404
Region Missing	.010	.098	.041	.197
Urban Resident[I]	.721	.449	.611	.488
Urban Missing	.036	.186	.107	.309
Observations	13390		4814	

Notes:
All dollar values are in $1998.
[a] Every year that an individual is included in the sample is a separate observation. Therefore the means and standard deviations in the pooled sample refer to woman-year and married-man-year observations.
[b]Health variables are defined as follows: Body Mass Index (BMI) = weight in kg/(height in meters squared); Obese = 1 if BMI>=30; Overweight = 1 if BMI>=25 & <30; Underweight = 1 if BMI<18.5
[c]Current Resources refer to a respondent's income and social program participation in the calendar year preceding the interview year. FS eligibility income excludes the value of FS benefits from total family income
[d]Long-term Resources refer to a respondent's income and social program participation in the survey years starting six years and ending two years prior to the current interview year. LT Income-to-Needs Ratio – 1 is equal to the average FS eligibility income-to-needs ratio over this period if a respondent has data in each of the five previous survey years, and is equal to zero otherwise. LT Income-to-Needs Ratio – 2 is equal to the average FS eligibility income-to-needs ratio over this period if a respondent has data in fewer than five of the five previous survey years, and is equal to zero otherwise. LT FSP Participation Missing – 1 is equal to one if a respondent is dependent in any of the five previous survey years, and equal to zero otherwise. LT FSP Participation Missing – 2 is equal to one if a respondent is missing data on FSP participation in any of the five previous survey years and has not been dependent over this period, and is equal to zero otherwise.
[I]These variables are interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable)

Table 2: OLS Regressions of Obesity on Food Stamp Program Participation, Women

	(1)		(2) *Fixed Effects*		(3)		(4) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	.00239*	.00068	.00027	.00052	…	…	…	…
Total Family Income	…	…	…	…	.00234*	.00067	.00031	.00052
FSP Participant	.0511*	.012	.0199*	.0099	.0457*	.012	.0196*	.0097
FS Benefit Amount	…	…	…	…	…	…	…	…
LT Income-to-Needs Ratio – 1	-.0095*	.0034	-.0007	.0068	-.0095*	.0034	-.0007	.0068
LT Income-to-Needs Ratio – 2	-.0033	.0026	.0010	.0033	-.0033	.0026	.0010	.0033
# Years of FS Eligibility in Prev. 5[I]	-.0006	.0052	-.005	.005	-.0007	.0052	-.005	.005
LT FS Eligibility Missing	-.036	.023	-.013	.024	-.037	.023	-.013	.024
# Years of FSP Participation in Prev. 5[I]	.0158*	.005	.0085*	.004	.0156*	.0049	.0085*	.004
LT FSP Participation Missing – 1	.039*	.016	.010	.014	.038*	.016	.010	.014
LT FSP Participation Missing – 2	.024	.020	.009	.018	.024	.020	.009	.018
Number of Observations	13161		13161		13161		13161	

Notes:
Obesity = 1 if Body Mass Index (weight in kilograms/height in meters squared) >=30. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, marital status, family size, pregnancy status, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level.
[I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 3: OLS Regressions of Obesity on Food Stamp Program Participation, Women

	(5)		(6) *Fixed Effects*		(7)		(8) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	.0021*	.00066	.00025	.00051	…	…	…	…
Total Family Income	…	…	…	…	…	…	…	…
FSP Participant	…	…	…	…	…	…	…	…
FS Benefit Amount	.0087**	.0049	.0058	.0036	…	…	…	…
LT Income-to-Needs Ratio – 1	-.0097*	.0034	-.0008	.0068	-.010*	.0035	-.0010	.0068
LT Income-to-Needs Ratio – 2	-.0040	.0025	.0010	.0033	-.0036	.0026	.0008	.0033
# Years of FS Eligibility in Prev. 5[I]	-.0001	.0052	-.0049	.0050	-.0019	.0053	-.0046	.0049
LT FS Eligibility Missing	-.035	.023	-.011	.024	-.043**	.023	-.010	.024
# Years of FSP Participation in Prev. 5[I]	.0181*	.0051	.0080*	.0039	.0190*	.0052	.0081*	.0039
LT FSP Participation Missing – 1	.044*	.017	.009	.014	.044*	.017	.001	.014
LT FSP Participation Missing – 2	.028	.020	.008	.018	.030	.021	.008	.018
Number of Observations	13161		13161		13161		13161	

Notes:
Obesity = 1 if Body Mass Index (weight in kilograms/height in meters squared) >=30. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, marital status, family size, pregnancy status, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level.
[I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 4: OLS Regressions of Obesity on Food Stamp Program Participation, Women - Alternative Specifications

	(9) *Fixed Effects*		(10) *Fixed Effects*		(11) *Fixed Effects*		(12) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
Total Family Income w/o AFDC Benefits	.00028	.00051	.00024	.00051	…	…	…	…
Total Family Income w/o FS or AFDC Benefits	…	…	…	…	.00034	.00051	.00034	.00051
Food Stamp Recipient	…	…	…	…	.023*	.011	.024*	.011
AFDC Recipient	.003	.011	.004	.012	-.008	.013	-.009	.013
LT Income-to-Needs Ratio – 1	-.0008	.0068	-.0011	.0068	-.0008	.0068	-.0008	.0067
LT Income-to-Needs Ratio – 2	.0007	.0033	.0006	.0033	.0010	.0033	.0010	.0033
# Years of FS Eligibility in Prev. 5[I]	-.0047	.0049	-.0027	.0049	-.0049	.0049	-.0049	.0049
LT FS Eligibility Missing	-.010	.024	-.004	.023	-.011	.024	-.011	.023
# Years of FSP Participation in Prev. 5[I]	.0082*	.0040	…	…	.0086*	.004	.012*	.0059
LT FSP Participation Missing – 1	.010	.014	…	…	.010	.014	…	…
LT FSP Participation Missing – 2	.009	.018	…	…	.010	.018	…	…
# Years of AFDC Participation in Prev. 5[I]	…	…	.0035	.0043	…	…	-.0053	.0063
LT AFDC Participation Missing	…	…	-.004	.013	…	…	.009	.014
Number of Observations	13161		13161		13161		13161	

Notes:
Obesity = 1 if Body Mass Index (weight in kilograms/height in meters squared) >=30. The table reports Huber-White standard errors; models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models also include controls for hours worked per week, marital status, family size, pregnancy status, highest grade completed, college enrollment status, region, urban residence, occupation and time and time-squared. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level. [I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 5: OLS Regressions of Body Mass Index on Food Stamp Program Participation, Women

	(1)		(2) *Fixed Effects*		(3)		(4) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	.033*	.011	.0089**	.0052	…	…	…	…
Total Family Income	…	…	…	…	.032*	.011	.0095*	.0052
FSP Participant	.780*	.180	.186*	.089	.714*	.177	.171**	.087
FS Benefit Amount	…	…	…	…	…	…	…	…
LT Income-to-Needs Ratio – 1	-.192*	.056	-.021	.055	-.193*	.056	-.021	.056
LT Income-to-Needs Ratio – 2	-.091*	.035	-.041	.030	-.090*	.035	-.041	.029
# Years of FS Eligibility in Prev. 5[I]	.007	.083	-.077**	.044	.006	.083	-.077**	.045
LT FS Eligibility Missing	-.681**	.355	-.274	.213	-.687**	.355	-.274	.214
# Years of FSP Participation in Prev. 5[I]	.254*	.074	.146*	.040	.251*	.074	.145*	.040
LT FSP Participation Missing – 1	.799*	.256	.266**	.144	.791*	.256	.265**	.142
LT FSP Participation Missing – 2	.673*	.317	.346*	.176	.665*	.317	.345*	.176
R-squared	.114		.904		.114		.904	
Number of Observations	13161		13161		13161		13161	

Notes:
Body Mass Index = weight in kilograms/height in meters squared. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, marital status, family size, pregnancy status, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level. [I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 6: OLS Regressions of Body Mass Index on Food Stamp Program Participation, Women

	(5)		(6) *Fixed Effects*		(7)		(8) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	.028*	.010	.009*	.0052	…	…	…	…
Total Family Income	…	…	…	…	…	…	…	…
FSP Participant	…	…	…	…	…	…	…	…
FS Benefit Amount	.133	.082	.063**	.033	…	…	…	…
LT Income-to-Needs Ratio – 1	-.195*	.057	-.021	.056	-.204*	.058	-.025	.056
LT Income-to-Needs Ratio – 2	-.101*	.035	-.041	.029	-.097*	.036	-.044	.029
# Years of FS Eligibility in Prev. 5[I]	.015	.083	-.076**	.045	-.0073	.083	-.074**	.045
LT FS Eligibility Missing	-.655**	.356	-.273	.214	-.756*	.359	-.272	.214
# Years of FSP Participation in Prev. 5[I]	.290*	.077	.141*	.040	.307*	.079	.141*	.040
LT FSP Participation Missing – 1	.871*	.259	.259**	.144	.890*	.265	.261**	.144
LT FSP Participation Missing – 2	.731*	.319	.335**	.175	.761*	.323	.338*	.176
R-Squared	.113		.904		.112		.904	
Number of Observations	13161		13161		13161		13161	

Notes:
Body Mass Index = weight in kilograms/height in meters squared. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, marital status, family size, pregnancy status, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level. [I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 7: OLS Regressions of Body Mass Index on Food Stamp Program Participation, Women - Alternative Specifications

	(9) *Fixed Effects*		(10) *Fixed Effects*		(11) *Fixed Effects*		(12) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
Total Family Income w/o AFDC Benefits	.010**	.0051	.0098*	.0052	…	…	...	…
Total Family Income w/o FS or AFDC Benefits	…	…	…	…	.010*	.0052	.010*	.0052
Food Stamp Recipient	…	…	…	…	.206*	.101	.199**	.103
AFDC Recipient	.091	.107	.102	.107	-.002	.122	.007	.123
LT Income-to-Needs Ratio – 1	-.021	.055	-.023	.057	-.021	.056	-.021	.056
LT Income-to-Needs Ratio – 2	-.043	.029	-.046	.029	-.041	.030	-.042	.030
# Years of FS Eligibility in Prev. 5[I]	-.074**	.045	-.054	.044	-.077**	.045	-.074**	.045
LT FS Eligibility Missing	-.264	.213	-.165	.206	-.272	.213	-.232	.207
# Years of FSP Participation in Prev. 5[I]	.143*	.040	…	…	.147*	.040	.114*	.054
LT FSP Participation Missing – 1	.263**	.144	…	…	.267**	.145	…	…
LT FSP Participation Missing – 2	.338**	.176	…	…	.347*	.177	…	…
# Years of AFDC Participation in Prev. 5[I]	…	…	.123*	.044	…	…	.041	.060
LT AFDC Participation Missing	…	…	.142	.122	…	…	.271**	.140
R-squared	.904		.904		.904		.868	
Number of Observations	13161		13161		13161		13161	

Notes:
Body Mass Index = weight in kilograms/height in meters squared. The table reports Huber-White standard errors; models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models also include controls for hours worked per week, marital status, family size, pregnancy status, highest grade completed, college enrollment status, region, urban residence, occupation and time and time-squared. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level.
[I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 8: OLS Regressions of Obesity on Food Stamp Program Participation, Married Men

	(1)		(2) *Fixed Effects*		(3)		(4) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	-.0022*	.0011	.00042	.00086	…	…	…	…
Total Family Income	…	…	…	…	-.0023*	.0011	.00041	.00087
FSP Participant	.0021	.022	.015	.020	.0057	.022	.014	.020
FS Benefit Amount	…	…	…	…	…	…	…	…
LT Income-to-Needs Ratio – 1	-.00038	.010	.016	.015	.00038	.010	.016	.015
LT Income-to-Needs Ratio – 2	.0072	.010	.0071	.015	.0072	.010	.0071	.015
# Years of FS Eligibility in Prev. 5[I]	.0037	.0095	.0096	.0081	.0036	.0095	.0096	.0081
LT FS Eligibility Missing	-.0021	.046	.024	.047	-.0023	.046	.024	.047
# Years of FSP Participation in Prev. 5[I]	.0063	.011	-.0023	.0092	.0064	.011	-.0023	.0093
LT FSP Participation Missing – 1	-.015	.024	-.035	.022	-.015	.024	-.035	.022
LT FSP Participation Missing – 2	-.050	.032	-.066*	.032	-.050	.032	-.066*	.032
R-Squared	.06		.83		.83		.83	
Number of Observations	4718		4718		4718		4718	

Notes:
Obesity = 1 if Body Mass Index (weight in kilograms/height in meters squared) >=30. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, family size, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level. [I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 9: OLS Regressions of Obesity on Food Stamp Program Participation, Married Men

	(5)		(6) *Fixed Effects*		(7)		(8) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	-.0023*	.0011	.00035	.00087	…	…	…	…
Total Family Income	…	…	…	…	…	…	…	…
FSP Participant	…	…	…	…	…	…	…	…
FS Benefit Amount	-.0037	.0088	.0032	.00803	…	…	…	…
LT Income-to-Needs Ratio – 1	-.0004	.010	.016	.015	.00013	.010	.017	.016
LT Income-to-Needs Ratio – 2	.0068	.010	.0069	.015	.0027	.010	.0068	.015
# Years of FS Eligibility in Prev. 5[I]	.0038	.0095	.0098	.0081	.0076	.0097	.01	.0081
LT FS Eligibility Missing	-.0011	.046	.024	.047	.016	.046	.025	.047
# Years of FSP Participation in Prev. 5[I]	.0073	.011	-.0026	.0092	.0082	.012	-.0027	.0092
LT FSP Participation Missing – 1	-.014	.025	-.036**	.022	-.010	.025	-.036**	.022
LT FSP Participation Missing – 2	-.050	.032	-.066*	.032	-.046	.033	-.067*	.032
R-Squared	.06		.83		.059		.83	
Number of Observations	4718		4718		4718		4718	

Notes:
Obesity = 1 if Body Mass Index (weight in kilograms/height in meters squared) >=30. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, family size, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level. [I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 10: OLS Regressions of Body Mass Index on Food Stamp Program Participation, Married Men

	(1)		(2) *Fixed Effects*		(3)		(4) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	-.021	.015	.00094	.0066	…	…	…	…
Total Family Income	…	…	…	…	-.022	.015	.0014	.0065
FSP Participant	-.052	.268	.229	.183	-.020	.26	.228	.185
FS Benefit Amount	…	…	…	…	…	…	…	…
LT Income-to-Needs Ratio – 1	.045	.117	.079	.070	.045	.117	.079	.071
LT Income-to-Needs Ratio – 2	.095	.121	-.061	.132	.096	.121	-.061	.131
# Years of FS Eligibility in Prev. 5[I]	.015	.116	.025	.069	.013	.115	.025	.069
LT FS Eligibility Missing	.045	.544	.389	.347	.040	.544	.388	.347
# Years of FSP Participation in Prev. 5[I]	.157	.140	.179**	.104	-.159	.140	.179**	.104
LT FSP Participation Missing – 1	-.158	.284	.039	.174	-.158	.284	.039	.174
LT FSP Participation Missing – 2	-.349	.388	-.180	.207	-.349	.388	-.180	.207
R-Squared	.0972		.93		.0973		.93	
Number of Observations	4718		4718		4718		4718	

Notes:
Body Mass Index = weight in kilograms/height in meters squared. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, family size, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level. [I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Table 11: OLS Regressions of Body Mass Index on Food Stamp Program Participation, Married Men

	(5)		(6) *Fixed Effects*		(7)		(8) *Fixed Effects*	
	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error	Coeff.	Robust Std. Error
FS Eligibility Income	-.023**	.014	.00084	.0066	…	…	…	…
Total Family Income	…	…	…	…	…	…	…	…
FSP Participant	…	…	…	…	…	…	…	…
FS Benefit Amount	-.080	.110	.083	.086	…	…	…	…
LT Income-to-Needs Ratio – 1	.045	.117	.079	.070	.050	.119	.079	.070
LT Income-to-Needs Ratio – 2	.091	.120	-.064	.132	.057	.124	-.064	.132
# Years of FS Eligibility in Prev. 5[I]	.016	.115	.025	.070	.049	.119	.031	.068
LT FS Eligibility Missing	.058	.544	.391	.346	.198	.558	.405	.351
# Years of FSP Participation in Prev. 5[I]	.172	.141	.175**	.101	.168	.153	.172**	.101
LT FSP Participation Missing – 1	-.143	.287	.033	.172	-.119	.291	.025	.169
LT FSP Participation Missing – 2	-.339	.388	-.188	.205	-.313	.391	.191	.204
R-Squared	.0974		.9295		.0963		.9294	
Number of Observations	4718		4718		4718		4718	

Notes:
Body Mass Index = weight in kilograms/height in meters squared. The table reports Huber-White standard errors; odd-numbered models cluster on the individual, even-numbered models cluster on the household. All dollar values are in $1998 and all income variables are in thousands of dollars. Models without fixed effects also include controls for hours worked per week, age, age-squared, race and ethnicity, family size, highest grade completed, college enrollment status, AFQT score, mother and father's highest grade completed, region, urban residence, occupation and time and time-squared. Fixed-effects models exclude time-invariant variables as well as the age and age-squared terms. Single (double) asterisk(s) indicate statistically significant at the .05(.10) level. [I]Variable is interacted with an indicator for non-missing data (the variable is set equal to zero if a respondent is missing information for this variable).

Appendix Table A: Summary of Instrumental Variable Data Sources

AFDC Payments
Years: 1979-1997
Unit of analysis: Yearly average *monthly* benefit of AFDC/TANF recipients by state
Source: U.S. Administration for Children and Families, Quarterly Public Assistance Statistics.

Food Stamp Payments
Years: 1980, 1985, 1990-1999
Unit of analysis: Average benefits per recipient *per year* by state
Sources: U.S. Statistical Abstract from "Annual Historical Review of FNS Programs" and
http://www.fns.usda.gov/fns

Medicaid Payments
Years: 1979-1990, 1992-1998
Unit of analysis: Average benefits per recipient *per year* by state
Sources:
1979-1990: HCFA, EDG, OIS, Division of Information Distribution
Contact: Tony Parker (410)786-0155
1991-1998: U.S. Statistical Abstract

AFDC maximum grant
Years: 1981-1994, 1996-1997
Unit of analysis: Yearly average of *monthly* maximum grant for a family of four
Source: Green Book

AFDC need standard
Years: 1985-1994, 1996-1997
Unit of analysis: Yearly average of *monthly* need standard for a family of four
Source: Green Book

Endnotes

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[2] The prevalence of obesity in the United States has been steadily rising since the 1970s. Using the 1976-1980 National Health and Nutrition Examination Survey (NHANES) II, Chou *et al.* (2001) estimate that the average BMI was 25.16, the percentage obese was 13.9% and the percentage overweight or obese was 44.4% for individuals 18 and older. Using the 1988-1994 NHANES III for the same age ranges they estimate that the average BMI grew to 26.4, the percentage obese grew to 21.6% and the percentage overweight or obese grew to 53.4%. BMI is defined as weight in kilograms divided by height in meters squared. They define a person as overweight if his or her BMI is greater than or equal to 25 and less than 30 and as obese if his or her BMI is greater than or equal to 30.

[3] Historically, the amount of nutrition education provided by the FSP has been minimal. The nutrition education component of the FSP will be discussed in more detail later in the paper.

[4] They categorize the studies as showing an inverse association, no association or a direct association between SES and obesity. They do not examine whether there is evidence of a u-shaped or inverted u-shaped relationship between SES and obesity. As will be discussed later in this section, based on a theoretical model of obesity, Lakdawalla and Philipson (2001) hypothesize that there is an inverted u-shaped relationship between income and obesity. Sobal and Stunkard also do not provide details on the SES measures used by each study or information on the size of the estimates of the relationship between SES and obesity.

[5] Jeffrey *et al.* (1991) divide the sample into low, medium and high SES categories. In their models including behavioral controls, women in the low SES category have a predicted BMI 1.28 points higher than otherwise identical women in the high SES category; men in the low SES category have a predicted BMI 0.74 points higher than otherwise identical men in the high SES category.

[6] Croft *et al.* (1992) also group their sample into low, medium and high SES categories. In their models including behavioral controls, the predicted BMI of a woman in the low SES category is 1.90 points higher than an otherwise identical woman in the high SES category.

[7] However, the size of the effect depends on the specification of the model. In NHIS models with controls for the strength and strenuousness of a respondent's current occupation, the biggest predicted difference between income quartiles is 0.243 units of BMI for men (between the 3rd and the 1st quartile) and 1.50 units of BMI for women (between the 1st and the 4th quartile). The coefficients in equivalent models using the NLSY79 are very similar. In NLSY79 models including the stock of strength and strenuousness requirements of occupational physical requirements and individual fixed-effects, the biggest predicted difference in BMI between income deciles is 0.163 units of BMI for men (between the 7th and the 1st deciles) and 0.52 units of BMI for women (between the 1st and the 10th deciles).

[8] This model does not include individual fixed effects. The largest difference in the predicted effect of unearned income is 2.65 additional units of BMI for those women with spouses in the 2nd wage decile as compared to those in the 10th wage decile.

[9] In models excluding (including) hours of work or wages a $1000 increase in income reduces predicted BMI by 0.013 (0.015) points and reduces the probability of both overweight and obesity by .1 (.1) percentage points. Holding all else constant, a two standard deviation increase in income ($49,254) results in a predicted decrease in BMI of 0.637 points and reduces the probability of overweight and obesity by 4 percentage points. They do not run their models separately by sex, so it is not possible to test whether the relationship between weight and income is different for men or women.

[10] Fraker (1990) reviews 17 previous studies on the relationship between FSP participation and food expenditures. Devaney and Fraker (1989) examine how the construction of sample weights in the 1977-1978 Nationwide Food and Consumption Survey results in a wide range of estimates of the relationship between FS, income and food expenditures depending on whether sampling weights are used in the

estimation. Levedahl (1991) and also Levedahl (1995) focus on how estimates of the marginal propensity to consume food out of FS are highly dependent on the functional form used in the estimation.

[11] Mathematica (2000) points out that much of the previous research is based on data from the 1970's, some of it collected prior to the elimination of the purchase requirement in the FSP. They note that the effects of FSP participation on food expenditures under this system may differ from the effects of benefits under the current system. However, studies using later data find estimates in the same range as the studies using older data (for example: Senauer and Young (1986) and Levedahl (1995)).

[12] These estimates exclude one of two Alabama demonstrations, primarily because it was a short-term demonstration that lasted only eight months. Fraker *et al.* suggest that this program may not have lasted long enough to induce any expenditure changes. The other demonstration programs were designed to run for at least four years. To come up with their estimates of the reduction in food expenditures per dollar of FS cashed out, they normalize the difference in food expenditures between FS coupon and cash benefit households by the average FS benefit of all recipient households at each demonstration site. This takes into account their assumption that as FS benefits decline, the replacement of coupons with cash will result in a smaller change in total food expenditures.

[13] A number of surveys such as the 1979-1980 Survey of Food Consumption of Low-Income Households collect information on "household food use." This refers to food and beverages used from household food supplies and excludes food eaten away from home. Previous research has used the term "nutrient availability" to refer to the nutritional content of food consumed from household food supplies. Past studies generally find a positive and significant relationship between FSP participation and nutrient availability (Fraker 1990). In contrast to nutrient availability, research on "nutrient intake" examines the nutritional content of *all* food consumed during a time period.

[14] Fraker (1990) reviews six early studies of the impact of FS on nutrient intakes that use data from or prior to the early 1980s. Fraker points out that these studies show little consistency in the impact of FSP participation. "The signs of the estimated FS effects often vary greatly across nutrients within the same study and across studies for the same nutrient. Only a small portion of the effects are statistically significant." As quoted in Mathematica (2000).

[15] Participation in the FSP increases the predicted number of servings of meat by .25 (the recommended daily amount is 5-7 servings), added sugars by 1.99 teaspoons (the recommended daily maximum amount is 6-18 teaspoons), and total fat by 4.00 grams (the recommended daily maximum amount 53-93 grams). Wilde *et al.* calculate the effect on intakes of increasing per capita income from $162 to $375 per month for individuals of different ages (these values are respectively the average income of households in the lowest and highest income quartiles in their sample). This increase in income results in a predicted increase in the consumption of servings of meat that is greater than that due to FSP participation. However, for added sugars and total fat, this increase in income does not result in a consistently higher predicted impact on consumption than for FSP participation. For some ages the predicted change in added sugar and total fat consumption as a result of the income change is higher than that of FSP participation and for some it is lower.

[16] The 10 component indices of the HEI measure whether certain types of foods are consumed in adequate amounts, whether other foods are consumed in moderation and finally whether a variety of foods are consumed.

[17] The break-even amount of FS benefits is $17.54 per week. The average FS benefit of $34.22 raises the predicted aggregate household HEI by 3.7 points (the average aggregate household HEI in the sample is 62.18 points).

[18] Higher values equal "better" nutrition.

[19] In models of obesity that control for Food Stamp Program participation, Bhattacharya and Currie (2000) treat all of the explanatory variables as exogenous. In a similar reduced-form equation, Chou *et al*. (2001) also treat all of the explanatory variables as exogenous. The main differences between the two reduced-form models is that Bhattacharya and Currie drop prices from their reduced-form equation and Chou *et al*. include prices but only include values of the explanatory variables for the year in which the weight outcomes are measured. Whether it is reasonable to assume that the explanatory variables are exogenous will be discussed in detail in Section 5.

[20] Since the empirical models estimated in this paper are reduced-form models of the demand for health, they should only include controls for input prices, resources and other variables that may affect the productivity of health inputs. Therefore none of the empirical models include controls for behaviors that

affect obesity such as smoking and exercise, with the exception of the inclusion of controls for occupation since it is treated as exogenous.

[21] If an individual is underweight, increasing expenditures on the enjoyment of meals (assuming calorie consumption rises more than calories expended) should lead to weight gain and improved health.

[22] The amount of nutrition education provided by the FSP has varied substantially over time and across states. Under the FSP regulations, states are allowed to run their own nutrition education plans (NEPs). If state NEPs are approved by the Food and Nutrition Service of the USDA, states are reimbursed for 50% of the allowable costs expended. However, there is no requirement that states provide nutrition education. Only 9 states had NEPs in 1992, and 49 states had NEPs as of 1999 (USDA 1999). Characteristics of NEPs such as primary nutrition goals, implementing agency, target audience and method of information delivery vary across states (Health Systems Research 2000). It can be reasonably argued that the education component of the FSP is still minimal, given that the average expenditure on nutrition education per FSP participant by the USDA's Food and Nutrition Service was $2.11 in 1998 (USDA 1999). Therefore it is expected that the "productive efficiency" and "allocative efficiency" effects due to FSP participation are relatively small.

[23] A more restrictive definition of eligibility is used to create variables used in the regression analyses.

[24] Unmarried men are excluded from the analyses since their rate of participation in the FSP is very low. Only 10% of unmarried-man-year observations are FSP participants and the average yearly FS benefit amount is $138. This compares to 20% of married-man-year observations that are FSP participants and an average yearly FS benefit amount of $410.

[25] Previous work by Cawley (2000) suggests that self-reported weight and height in the NLSY79 may be misreported. To correct for this possibility he uses the relationship between actual and self-reported measures of a respondent's weight and height from the NHANES III to correct the self-reported weight and height data in the NLSY for measurement error. He estimates models of the relationship between wages and BMI with and without correcting for reporting error in weight and height and finds similar results in both specifications. The correction is not used in the analyses in this paper.

[26] Observations are excluded from the sample in years where data on weight are not collected or years where respondents did not respond to questions about weight. Since weight data were not collected in 1979, 1980, 1983, 1984, 1987 and 1991, these years do not enter the sample as a "current" year. However these years of data are used to create the long-term eligibility and long-term FS receipt variables that are discussed later in this section.

[27] A person who is 5'5" has a BMI of 25 at a weight of 145.3 pounds and a BMI of 30 at 174.4 pounds. A person who is 6'0" has a BMI of 25 at a weight of 178.6 pounds and a BMI of 30 at 214.3 pounds.

[28] As mentioned previously, the education component of the FSP has been relatively small to date. Therefore, any relationship between FSP participation and obesity is most likely the result of FS benefits rather than the nutrition education provided to participants.

[29] It could be argued that health insurance belongs in these models because health insurance may lead to increased utilization of the medical system and increased utilization of the medical system may lead to reduced obesity. Gruber (2000) summarizes the research on this topic with respect to Medicaid. I decided to exclude health insurance status for a number of reasons. The first is that estimates of the relationship between health insurance status and health are likely to be biased because of omitted variable bias or the simultaneity of health and health insurance status (Gruber 2000). The second is that the few studies that examine the relationship between health and health insurance status or eligibility and attempt to correctly deal with the potential biases find limited or no relationship between health outcomes and health insurance (Kaestner *et al.* 1999; Gruber 2000). The final reason is that other research on health outcomes, where the effect of insurance on health is not of primary interest, exclude insurance as a control (for example: Korenman and Miller 1992; Currie and Cole 1993; Miller and Korenman 1994; Bhattacharya and Currie 2000; Chou *et al.* 2001; Lakdawalla and Philipson 2001).

[30] Chou *et al.* (2001) also specify the time trend this way rather than using indicator variables for each year of the sample.

[31] Given equation (1), including individual fixed effects also removes the need to control for the initial health endowment of the individual.

[32] Lakdawalla and Philipson (2001) also make this choice using data from the NLSY79 in models of BMI with individual fixed effects.

[33] All of the dollar values in this paper are in 1998 dollars.

[34] As an example, there were 19 income components of this variable in 1992 (Center for Human Resources Research 1999). Observations with missing current total family income are excluded from the sample. Using the NLSY79, Currie and Cole (1994) create an alternative measure of family income that deals with outliers and missing data. However their method is somewhat ad hoc and it is not used here.
[35] Note that the poverty guidelines are not the same as the poverty thresholds issued by the Census Bureau. The poverty guidelines are a simplification of the poverty thresholds and are used to determine the financial eligibility for some federal programs, among them the Food Stamp Program. The poverty guidelines are available on-line at http://aspe.hhs.gov/poverty/figures-fed-reg.htm
[36] Mathematica (2000) and Bhattacharya and Currie (2000) also define Food Stamp eligibility in this way. One definition of eligibility for the FSP considered by Blank and Ruggles (1996) is based only on current family cash income.
[37] Blank and Ruggles (1996) use a sample of single mothers from the 1986 and 1987 panel files of the Survey of Income and Program Participation (SIPP). Using a definition of eligibility for the FSP based only on current cash income, 10% of FSP participants are "ineligible."
[38]Blank and Ruggles (1996) also consider alternative definitions of eligibility for the FSP. If they define eligibility for the FSP based on current cash income and asset limits (excluding car values) they calculate that 14% of FSP participants are "ineligible." If they instead include the excess value of cars in the asset limits, they calculate that 18% FSP participants are "ineligible."
[39]To provide an example, the measure of long-term eligibility for the 1992 survey year uses the interviews from 1987 through 1991, which measure income in the calendar years 1986 through 1990. This definition of long-term eligibility results in removing all observations in the survey years prior to 1984 from the sample since they do not have 5 previous years of income data. However, this restriction actually results only in the removal of 1981 and 1982 since the others years were already removed because they lacked current weight information.
[40] Alternative specifications of long-term eligibility using indicators for the number of years of eligibility in the previous five years instead of the continuous variable were also tried in some of the empirical models. The results of these models are similar to the results with the continuous variable for long-term eligibility.
[41] Alternative specifications of long-term FSP participation used indicators for the number of years of FS receipt in the previous five. These models have similar results to the models with continuous long-term FSP participation variables. An interaction of long-term eligibility and long-term FSP participation was also included in some of the empirical models but the coefficient on this variable is never significant.
[42] FSP participation is not the only variable that is potentially endogenous. Wages, income, occupational choice and marital status may all be affected by obesity. Recent work examines the determinants of wages and attempts to control for the potential endogeneity of obesity using same-sex sibling differences or the BMI of a child as an instrument for parental BMI. This research finds that BMI and obesity are negatively related to wages and income for women (Averett and Korenman 1996; Cawley 2001). Wolpin and Rosenzweig (2001) estimate the influence of BMI on wages using a sample of female identical twins. They find that, "the significant inverse association between adult BMI and wages found in cross-sectional estimates solely reflects a correlation between unmeasured earnings endowments and BMI, and disappears with controls for endowments common to monozygotic twins." Averett and Korenman (1996) find that for women there is a negative relationship between obesity and the likelihood of marriage. They find weaker evidence for men. Gortmaker *et al.* (1993) find a negative and significant relationship between obesity and marital status for both men and women (although they do not control for the possibility of endogeneity). Cawley (2000) finds that BMI is not significantly related to the probability a woman is employed or to the likelihood she is employed in a white collar versus a blue-collar job. Pagan and Davila (1997) find that the occupational distribution of the obese differs significantly from that of the non-obese. However the direction of causality is unclear from their analysis.
[43] Indicators for missing values of current and long-term instruments are also included as instruments. The source of these variables and the years for which data are available are provided in Appendix Table A.
[44] Bound, Jaeger and Baker (1995) show that weak instruments can lead to a large inconsistency in IV estimates if there is even a weak correlation between the instruments and the error in the original equation. Additionally, in finite samples IV estimates are biased in the same direction as OLS estimates. The bias approaches the OLS bias as the R-squared between the endogenous explanatory variables and the instruments approaches zero.

[45] The alternative specifications of the first stage of the IV estimation included many different possible formulations of the instruments and the inclusion and removal of all additional variables that might possibly be endogenous.

[46]The passage of the Personal Responsibility and Work Opportunity Act of 1996 ("welfare reform") created Temporary Aid for Need Families (TANF) as a replacement for Aid to Families with Dependent Children (AFDC). TANF became effective July 1, 1997 and there is a great deal of state-level variation in TANF programs. Examples include differences across states in time limits, types of exemptions from time limits, activities that count toward work requirements, sanctions for not complying with work requirements, family cap provisions, earnings and asset disregards and maximum benefit levels. A summary of state-level differences in TANF post welfare reform is available on-line from the U.S. Department of Health and Human Services at http://www.acf.dhhs.gov/programs/ofa. A subset of these variables may work as instruments for FSP participation since recipients of AFDC/TANF or SSI are automatically eligible for FS (USDA 2001).

Welfare reform also introduced additional state-level variation in the FSP. A major change in the FSP is that able-bodied adults without dependents (often referred to as ABAWDs) may only receive FS for 3 months in a 36-month period unless they work 20 hours per week, participate in an approved work or training program, or live in an area that has been waived from the time limit due either to an unemployment rate higher than 10% or insufficient jobs. States are also allowed to exempt up to 15% of their unwaived ABAWD population from the 3-month time limit. Participation in the FSP is likely to be affected both by the existence of work requirement waivers and the absolute number of the allowable exemptions from work requirements. A summary of state-level differences in the FSP post welfare reform is available on-line from the U.S. Department of Agriculture at http://www.fns.usda.gov/fsp/MENU/ADMIN/WELFARE/SUPPORT

An important issue is that only the 1998 survey year of the NLSY79 is exposed to the post-welfare reform state-level variation. In future work I plan to estimate the empirical models with a cross section of observations from 1998 using some of the above-mentioned variables as instruments for FSP participation, however this will limit the age range in the sample to individuals between the ages of 33 and 41.

[47] These change numbers are calculated by taking the difference between the survey year in which a respondent became obese and the most recent previous observation for that respondent. It is important to note that this may *not* be the previous calendar year. In order to take this into account all regression models control for age and or period for each respondent-year observation.

[48] OLS models are discussed in the text rather than logistic regression models because of the ease of interpreting linear probability models. Logistic regression versions of all of the obesity models are available upon request. The patterns of signs and significance in the logit models are the same as in the equivalent OLS models.

[49] It would also be interesting to examine whether benefits from the Special Supplemental Nutrition Program for Woman, Infants and Children (WIC) have the same relationship to obesity as FSP participation. Information on WIC participation is not available in the NLSY79.

[50] The magnitudes of the coefficient estimates in models (1) – (12) are very similar to the results of Chou *et al.* (2001). However the signs of the coefficients are often reversed. This may be explained by the fact that Chou *et al.* use a sample that represents that entire U.S. population and the models in this paper only use individuals with an income-to-needs ratio less than two.

[51] In model (11) the F-statistic on the test of the hypothesis that the coefficient on FSP participation is equal to the coefficient on AFDC participation is 1.13 (prob > F = 0.286). The same type of argument that was made for obesity can be made in the case of BMI. Even if FSP and AFDC participation have the same relationship to obesity as a whole, the impact on BMI per dollar of benefits is higher for FS benefits since average FS benefits are lower than average AFDC benefits. In model (12) the F-statistic is 0.97 (prob > F = 0.32) for the test of the hypothesis that the coefficient on FSP participation is equal to the coefficient on AFDC participation and is 0.49 (prob > F = 0.48) for the test of the hypothesis that the coefficients on long-term FSP participation and long-term AFDC participation are equal. Once again, given the smaller dollar value of FS benefits it can argued that the impact on BMI per dollar of benefits is higher for FS benefits.

[52] This change in BMI occurs with an increase in weight of 1.06 pounds if an individual is 5'5".

[53] This change in BMI occurs with an increase in weight of 4.17 pounds if an individual is 5'5".

[54] The magnitude of the coefficient estimates in models (1) – (12) are similar in magnitude to the results of Chou *et al.* (2001) and Lakdawalla and Philipson (2001).

[55] This change in BMI occurs with an increase in weight of 6.32 pounds if an individual is 6'0".

[56] As was the case for women and BMI, the magnitude of the coefficient estimates in models (1) – (12) are similar in magnitude to the results of Chou *et al.* (2001) and Lakdawalla and Philipson (2001).