The effect of food stamps on fibre intake

David M. Zimmer[1]

Abstract

This paper examines the impact of food stamps on fibre intake, using data from the National Health and Nutrition Examination Study (NHANES), and a matching estimator to address possible endogeneity of food stamp participation with respect to dietary behaviour. Results suggest that food stamps reduce fibre intake by approximately 11 per cent. Food stamps also reduce the probability of reaching the daily recommended 20-gramme threshold by 18 per cent. But why do food stamps reduce fibre intake? A long-running concern is that, despite restrictions preventing food stamp recipients from using them at fast food/pizzas establishments, the fungible nature of household budgets might produce a link between food stamps and the consumption of such low-fibre fare. However, the data do not support that conjecture. Rather, the reason for reduced fibre intake appears to be that food stamp enrolees consume 50 per cent fewer servings of legumes (beans) and 30 per cent fewer servings of pasta/rice. Those foods, long associated with low-income diets, also happen to be rich in fibre.

JEL Classifications: I18, I38.
Keywords: obesity; safety net; propensity score, fibre intake, food stamps.

1. Introduction

This paper investigates whether food stamp participation leads to reduced fibre intake. Using survey data from the US Centers for Disease Control and Prevention, coupled with a matching estimator to address possible endogeneity concerns, the paper reaches three main conclusions. First, food stamps appear to reduce fibre intake by approximately 11 per cent. Second, food stamps also reduce the probability of reaching the recommended daily threshold of 20 grammes by 18 per cent. Third, the reason that food stamps reduce fibre intake is because food stamp enrolees reduce their consumption of foods long associated with low-income diets that also happen to be rich in fibre. Specifically, food stamp participants consume 50 per cent fewer servings of legumes (beans) and 30 per cent fewer servings of pasta/rice, compared to similar low-income individuals who do not receive food stamps.

The food stamp programme, formally known as the Supplemental Nutrition Assistance Program (SNAP), aims to lessen the historical link between poverty and decreased food consumption. Initiated by the Food Stamp Act of 1964, the programme guarantees low-income Americans an allotment of monthly funds for the purchase of food. During 2015, more than 45 million Americans received food stamps, at an average of $126.83 a month. Though the programme is viewed as a success in establishing food security, policy research has raised concerns about whether food stamp usage leads to poor dietary behaviours. Given the size and expense of the programme, coupled with the likelihood that food stamp recipients likely also receive government-subsidised health insurance, the topic has important public health and government finance implications.

Existing studies that examine the dietary effects of food stamps uncover evidence that food stamps lead to increases in obesity, particularly among women (Gibson 2003; Meyerhoefer and Pylypchuk 2008; Baum 2011). The standard explanation for that relationship is that food stamps, by lowering the cost of food, potentially increase calorie intake. This paper investigates an alternative explanation: Food stamps might alter the *composition* of caloric intake, in particular by reducing consumption of fibre. In addition to helping regulate blood cholesterol and sugar levels, dietary fibre is also believed to help control obesity, in part by contributing to feelings of satiation, which in turn reduces over-eating (Howarth *et al* 2001). For this reason, the National Academy of Medicine recommends that adults consume at least 20 grammes of dietary fibre per day (Dietary Guidelines Advisory Committee 2015).

In addition to the effects of food stamps on obesity, another strand of research seeks to measure the effects of food stamps on nutrient intake. That literature, which appears in journals scattered across many academic disciplines, tends to produce conflicting results. Earlier studies tended to find little, if any, link between food stamps and nutrient intake; see, for example, Butler *et al* (1985) and the references cited therein. Some studies in the 1990s and early 2000s found positive effects of food stamps on nutrient intake (Devaney and Moffitt 1991; Basiotis *et al* 1998), while others found negative effects (Butler and Raymond 1996; Wilde *et al* 1999; Whitmore 2002). A recent review article finds little evidence that food stamps affect macro- or micro-nutrient intake (Andreyeva *et al* 2015).

The two studies most closely related to the present paper are Yen (2010) and Grummon and Taillie (2017). Yen investigates the effect of food stamps on fibre intake among children younger than ten years old, using survey data from the US Department of Agriculture (USDA). He attempts to account for endogeneity of food stamp enrolment using nonlinear function forms and a maximum likelihood estimator. He finds a small, negative link between food stamp enrolment and fibre intake among young children. Grummon and Taillie, by contrast, use household-level scanner data from Nielsen. Using simple regression methods, their results are similar to Yen's, although they do not attempt to correct for potentially endogeneity.

The present paper contributes to, and differs from, the existing literature in terms of its formal treatment of potential endogeneity. That is, among individuals eligible for food stamps, participation in the programme is not randomly assigned (Kreider *et al* 2012). Indeed, in the estimation sample considered below, only about 43 per cent of individuals eligible for food stamps actually receive them. The low take-up rate among the eligible population has long attracted the attention of policy researchers (Butler and Raymond 1996). The main implication of low take-up rates for this study is that participants might differ from non-participants in ways that correlate with fibre intake. For example, perhaps people who, for whatever reason, dislike fibre are also more likely to apply for food stamps.

The presence of such unobserved predispositions toward fibre and food stamps might create the erroneous perception that food stamps *cause* reduced fibre intake, when, in fact, the relationship stems from the types of people who tend to enrol in food stamps. Although most studies in this area do not attempt to correct for such bias, a few studies do, using methods such as Heckman-style selection models (Butler *et al* 1985; Devaney and Moffitt 1991; Butler and Raymond 1996), endogenous switching setups (Kim *et al* 2000), and person-level fixed effects (Baum 2011). The present paper, by contrast, appears to be the first of its type to exploit a propensity score approach. The main findings are similar in direction, but larger in magnitude, that previous studies that attempt to link food stamp enrolment to fibre intake.

2. Data

Data used throughout this study come from the National Health and Nutrition Examination Study (NHANES), conducted and published by the US Centers for Disease Control and Prevention (CDC). Initiated in the early 1960s with the intention of providing a nationally-representative snapshot of health and nutritional details of Americans, the NHANES is unique in its blending of interviews and physical examinations. This paper focuses on three biennial waves of the survey: 2007/2008, 2009/2010, and 2011/2012. Waves prior to 2007/2008 asked slightly different questions about food stamp participation, making comparisons with later periods tricky.

This paper considers all adults aged 20 and older, yielding an initial sample of 14,597 subjects. To isolate the population most relevant to food stamp participation, this paper focuses on subjects with family incomes below 130 per cent of the federal poverty line (FPL), which is the main eligibility cutoff for the programme. (For detailed eligibility rules, see http://www.fns.usda.gov/snap/eligibility.)

Individuals with family income *above* 130 per cent of the FPL *might* qualify for food stamps if they have certain disabilities or reside in states with relaxed eligibility standards, but people under 130 per cent of the FPL constitute the food stamp programme's main target population. However, even for those below 130 per cent of the FPL, participation requires that would-be recipients fill out a form and return it to a local government office. Despite not being onerous, that application process appears to substantially reduce enrolment among the eligible population. Focusing on the under-130 per cent of the FPL population drops the sample size to 4,808 subjects.

Of particular interest to this study is the Dietary Interview portion of the NHANES, conducted by a partnership between the CDC and the USDA. During the Dietary Interview, respondents provide details about their food and nutrient intake during the past 24 hours. The Dietary Interview consists of an in-person interview and a telephone follow-up three to ten days later. This paper ignores the telephone follow-up, as not all respondents participate in that part of the interview. Further, this paper deletes from the estimation sample 1,436 respondents who, during the in-person interview, claimed that their food/ nutrient intake during the past 24 hours was not 'usual', relative to their typical intake. The final estimation sample thus consists of 3,370 unique individuals.

All components of the NHANES contain person-specification identifiers that facilitate linking information across files. To that end, socioeconomic traits for each subject come from the Demographic Data files, while information on food stamp participation comes from the Food Security questionnaires. The estimation sample also includes several details about dwelling units, employment activity, and health status, each drawn from separate questionnaires and merged into the main estimation sample.

As a final point regarding construction of the estimation sample, the present paper does not use the provided sample weights for two reasons. First, it is not obvious how to adjust sample weights, which apply to the *full* NHANES survey, to the highly specific subpopulation under consideration here. Second, when one wishes to interpret estimated parameters as relating to economic 'structure', as is the case in this paper, then unweighted estimates are preferred (Cameron and Trivedi 2005 ch 24).

Table 1 reports sample means of calorie and fibre intake during the past 24 hours, partitioned by food stamp participation. Food stamp participants consume approximately 100 more calories than non-participants, a difference

Table 1: Average calorie and fibre intake during last 24 hours

	Food stamp participant?	
	Yes (n = 1,462)	No (n = 1,908)
Calories	2,152**	2,065
Fibre (grammes)	14.9**	17.0
Fibre grammes per calorie (times 100)	0.73**	0.88
At least 20 grammes of fibre?	0.22**	0.30

* differs from 'No' group at .10 level
** differs from 'No' group at .05 level

that is statistically significant at the 0.05 level. Despite that increased calorie intake, food stamp participants consume approximately two *fewer* grammes of fibre, a difference that also is significant at the 0.05 level. Figure 1 shows histograms of fibre intake for food stamp participants and non-participants. Distributions of fibre intake are skewed, with modes occurring in the mid-teens, and upper tails extending to about 80 grammes. But the distribution for participants (the shaded rectangles) clearly sits to the left of the distribution for non-participants (the non-shaded rectangles), indicating lower fibre consumption among food stamp participants.

Figure 1: Histograms of fibre intake

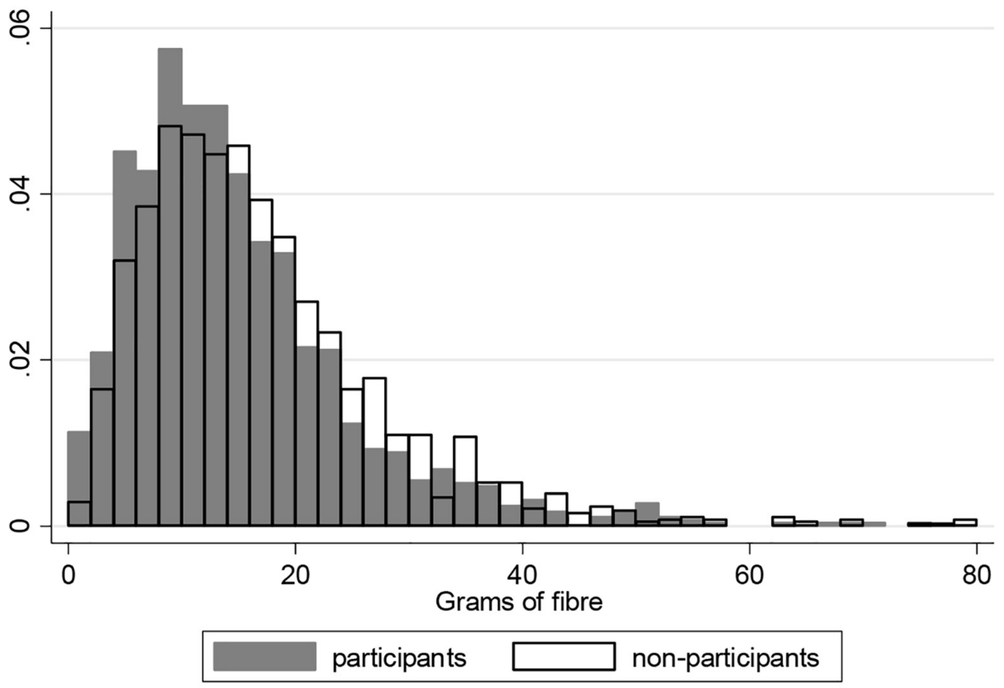


Table 1 also reports means for fibre intake *per calorie* consumed. Those numbers suggest that food stamp participants consume fewer grammes of fibre per calorie, which is not surprising considering the overall higher calorie and lower fibre intake among participants. As a final measure of fibre intake, the bottom row of Table 1 reports means for a binary indicator of whether subjects consume at least 20 grammes of fibre. The logic behind that measure is that fibre intake might be superfluous, or perhaps even harmful, above some level.

Perhaps it does not matter whether food stamps alter fibre intake, so long as subjects reach the recommended daily threshold of 20 grammes. As widely lamented among dietary experts, the average American fails to reach that recommended threshold (Lustig 2006), and that same pattern appears to apply to the low-income subjects considered here. Specifically, the numbers in the table reveal that only 22 per cent of food stamp participants reach the 20-gramme threshold, compared to 30 per cent of non-participants. That difference is significant at the 0.05 level.

The numbers in Table 1 suggest lower fibre consumption among food stamp participants, but those numbers do not provide *causal* impacts of food stamp enrolment because, as shown in Table 2, participants and non-participants differ across other socioeconomic dimensions. The variables listed in Table 2 are used in the econometric approaches described in the following section, in an attempt to control for factors that simultaneously affect food stamp participation and, possibly, fibre intake as well. Examining the sample means of those variables, participants are younger on average, and include a larger proportion of females, blacks, and US citizens, but a smaller fraction of Hispanics. Participants are less likely to be married, but more likely to have children. Not surprisingly, participants have lower mean education, lower incomes, and less attachment to work activities. Further, their health appears worse, on average. On the other hand, participants and non-participants appear equally likely to dwell in housing units connected to a city water source, which serves as a crude measure of proximity to urban infrastructure.

Table 2: Sample means for control variables

	Food stamp participant?	
	Yes (n = 1,462)	No (n = 1,908)
Age	45.0**	49.5
Female	0.56**	0.50
Black	0.26**	0.14
Hispanic	0.29**	0.33
Married	0.33**	0.42
Any children	0.68**	0.55
High school degree or higher	0.54**	0.60
US citizen	0.84**	0.76
Currently employed	0.35**	0.41
Family income as % of FPL	0.71**	0.85
Fair or poor health	0.33**	0.28
Owns house or paying mortgage	0.35**	0.46
Tap water from city source	0.64	0.63

* differs from 'No' group at .10 level
** differs from 'No' group at .05 level

The evidence that participants and non-participants differ across many observable traits raises the possibility of other differences across unmeasured dimensions, and that possibility is what clouds causal interpretations of the calorie and fibre numbers in Table 1. For example, perhaps low-income people who consume little fibre also happen to enrol in food stamp programmes. In that hypothetical case, lower fibre consumption will appear to be linked to food stamp participation when, if fact, the link does not derive from food stamp participation *per se*. The following section develops a matching framework that attempts to address the potential role of unobserved confounding factors.

3. Methods

Let y_i denote intake of some food component (e.g., calories or fibre) for person i. Let FS_i represent a dummy variable equaling one if the person receives food stamps, and zero if not. The baseline model follows a linear regression setup

$$y_i = X_i'\beta + \gamma FS_i + \varepsilon_i \quad (1)$$

where X_i denotes a vector of control variables, listed in Table 2, with estimable coefficients β. ε_i represents an error term. This paper considers four different measures of y_i, three of which employ the inverse hyperbolic sine transformation to account for skewness (Pence 2006), with marginal effects calculated using the method put forth by Norton (2022):

- $\sinh^{-1}$(calories)
- $\sinh^{-1}$(grammes of fibre)
- $\sinh^{-1}$(100 * grammes of fibre/calories)
- one if at least 20 grammes of fibre, and zero otherwise

The main parameter of interest, γ, captures the extent, if any, to which food stamps correlate with food component intake. If one further assumes the 'ignorability' condition,

$$y_{i,FS_i=0} \perp FS_i | X_i, \quad (2)$$

which implies independence between food stamp participation and food component intake under non-participation, then the coefficient γ provides the average treatment effect of the treated (ATT), the main measure of interest in most evaluations of public policy. That is, the parameter γ should capture the effect of food stamp participation among those who actually receive food stamps.

Unfortunately, unmeasured person-specific traits, beyond what can be included in the vector X_i, might simultaneously correlate with both FS_i and y_i, thus violating the ignorability assumption. Econometricians label this problem 'endogeneity' or 'selection', depending on interpretation. Common methods to address endogeneity include instrumental variables and longitudinal person-level fixed effects. Unfortunately, neither approach fits the modelling problem considered here.

First, the data lack obvious 'instruments' that affect food stamp participation, but not subsequent food intake, thus precluding instrumental variables estimation. And the fixed effects approach requires repeated observations of the same individuals over time, which stands in contrast to the cross-sectional structure of the NHANES. Even if repeated observations did exist, people likely do not show sufficient intra-person variation in food stamp enrolment and/or fibre intake across time periods, thus hindering the ability to precisely estimate the coefficient of food stamp enrolment.

Faced with those hurdles, this paper instead opts for a matching estimator based on estimated propensity scores. The procedure is as follows. First, for each person in the estimation sample, calculate the *probability* of food stamp participation conditional on observed values of all control variables. That probability is called the 'propensity score'. Next, match each food stamp participant to a non-participant with the closest propensity score. (The matching method uses 'replacement', meaning that each non-participant may be matched to more than one participant. Methods that use replacement tend to produce more stable findings compared to those that do not.) Finally, after matching participants and non-participants, the average difference between the two groups provides an estimate of the ATT.

The matching method described in the previous paragraph, labelled 'single nearest neighbor', is the simplest, and most transparent, propensity score-based matching algorithm. Alternative matching methods were also explored, including radius-based matches, kernel-based matching using different kernels, local linear matches, and methods that use multiple neighbors. Although the methods did not all produce identical results, the basic qualitative story did not change after using different matching algorithms. Therefore, all results presented below use the 'single nearest neighbor' approach.

Whatever the matching algorithm, validity of matching estimators hinges on two assumptions, neither of which is formally testable. The first is called 'conditional independence', formally defined as

$$y_{i,FS_i=1},\ y_{i,FS_i=0} \perp FS_i \mid \mathrm{X}_i \tag{3}$$

In words, conditional independence says that subjects with similar observed traits also share similar *unobserved* traits, such that endogeneity/selection stems from observable characteristics. The second assumption is called 'common support', formally defined as

$$0 < P(FS_i = 1 \mid \mathrm{X}_i) < 1 \tag{4}$$

which, in words, says that there exists sufficient overlap in the observed characteristics of participants and non-participants, such that adequate matches can be assembled. Although neither of these assumptions is formally testable, the overall quality of the participant/non-participant matches generated from the estimated propensity scores can be investigated and tested.

4. Results

This section first calculates propensity scores of food stamp participation used to generate matches. That discussion includes several diagnostic explorations of match quality. The section then turns its attention to the main results of interest: the effect of food stamps on fibre intake.

4.1. Propensity scores of food stamp participation

The first step of propensity score estimation involves calculating each subject's probability of receiving food stamps. To that end, Table 3 presents marginal effects from a probit estimation of food stamp participation. In that probit model, gender and Hispanic ethnicity do *not* appear to correlate with food stamp participation, which stands in contrast to findings from the simple tests of differences in sample means reported in Table 2. Otherwise, results from the probit model generally point to similar patterns uncovered by tests of differences in means.

Table 3: Probit estimates

Dependent variable = food stamp participant	Marg. eff.	St. err.
Age	–0.002**	0.001
Female	0.026	0.018
Black	0.132**	0.025
Hispanic	–0.014	0.025
Married	–0.052**	0.020
Any children	0.195**	0.021
High school degree of higher	–0.089**	0.019
US citizen	0.176**	0.024
Currently employed	–0.083**	0.020
Family income as % of FPL	–0.247**	0.028
Fair or poor health	0.068**	0.020
Own house or paying mortgage	–0.083**	0.019
Tap water from city source	–0.014	0.019

* significant at .10 level
** significant at .05 level

Using estimated coefficients from that probit model, an estimated probability – that is, a propensity score – of food stamp participation is calculated for each subject in the estimation sample. Each actual participant is then matched to a non-participant with the closest propensity score (using replacement). Table 4 shows means of covariates for participants and non-participants after matching.

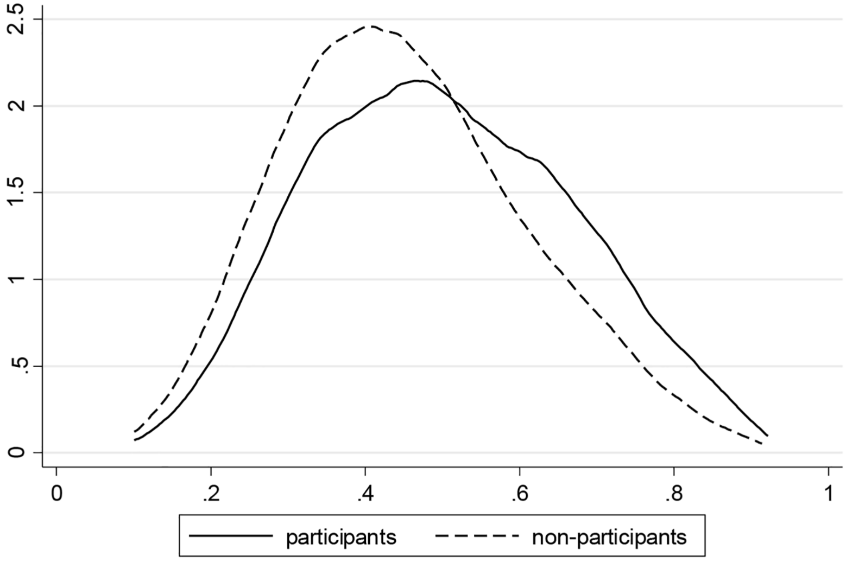
Table 4: Covariate balance after matching

	participants	non-participants
Age	45.0*	43.8
Female	0.56	0.54
Black	0.26	0.24
Hispanic	0.29	0.31
Married	0.33	0.31
Any children	0.68	0.68
High school degree or higher	0.54	0.54
US citizen	0.84	0.83
Currently employed	0.35	0.34
Family income as % of FPL	0.71	0.69
Fair or poor health	0.33	0.32
Owns house or paying mortgage	0.35	0.34
Tap water from city source	0.64	0.66

Overall test of covariate balance: Chi-square = 8.77 (p-value = 0.79)

* differs from 'non-participant' group at .10 level
** differs from 'non-participant' group at .05 level

Figure 2: Propensity score densities after matching



Despite participants being slightly older than their non-participating counterparts, the two groups appear appropriately 'balanced'. A formal chi-square test of overall balance, appearing at the bottom of Table 4, supports that conjecture. Proper balance implies that other explanatory variables, even if available and significantly important to food stamp participation, would not yield improved estimates of the propensity scores.

As discussed in the previous section, one of the key assumptions at the foundation of propensity score matching estimators is 'common support'. That assumption, though not formally testable, can be explored by examining distributions of propensity scores among participants and their matched non-participants. To that end, Figure 2 shows kernel density estimates of the propensity scores. The figure demonstrates significant overlap, with neither density showing a 'spike' absent from the other. Consequently, the estimated propensity scores should allow appropriate matches based on observed traits.

4.2. The effects of food stamps on fibre intake

Table 5 presents estimates of the effects of food stamps on food component intake, with particular emphasis on fibre. The first row presents simple ordinary least squares (OLS) regression estimates based on equation (1), but without any control variables. The second row adds the control variables listed in Table 2. Finally, the third row shows matching estimates. The first three columns employ an inverse hyperbolic sine transformation for the dependent variable, with marginal effects obtained using the method put forth by Norton (2022). The fourth column uses a linear probability setup.

Focusing first on total calorie intake, food stamp participants consume approximately 79.50 more calories than non-participants, but that relationship

Table 5: Effect of food stamps on calorie and fibre intake during previous 24 hours

	Calories	Fibre	Fibre/cal	≥ 20g fibre?
OLS (no controls)	79.50**	–2.63**	–0.142**	–0.076**
	(35.53)	(0.39)	(0.014)	(0.015)
OLS (controls)	49.05	–1.65**	–0.091**	–0.046**
	(34.03)	(0.40)	(0.014)	(0.016)
Propensity score match	26.37	–1.73**	–0.112**	–0.049**
	(53.17)	(0.55)	(0.024)	(0.023)

* significant at .10 level
** significant at .05 level
Numbers in the table represent marginals effects. Calories, Fibre, and Fibre/cal use an inverse hyperbolic sine transformation, with marginal effects calculated using the method put forth by Norton (2022). For ≥ 20g fibre the model uses a linear probability setup, so that number are directly interpreted as marginal effects. Standard errors appear in parentheses.

shrinks, and loses statistical significance, after adding controls. The relationship shrinks further, and remains insignificant, in the matching estimate. The implication is that, although food stamp participants appear to consume more calories, that relationship stems from the types of people who receive food stamps, not from food stamps themselves.

Turning attention to fibre intake in the second column, food stamp participants consume approximately 2.6 fewer grammes of fibre than non-participants. That relationship shrinks to 1.7 grammes once controls are added, and remains approximately 1.7 grammes in the matching setup. The average person in the estimation sample consumes 16.1 grammes of fibre per day, so 1.7 fewer grammes translates to an approximate 11 per cent reduction in fibre intake, relative to the sample mean. That 1.7-gram effect is similar in magnitude to the difference in mean fibre intake between participants and non-participants reported in Table 1.

The third column reports findings for grammes of fibre per calorie, with results appearing very similar to those for total fibre intake. Finally, recognising that fibre consumption might be superfluous past a certain point, the third column investigates whether food stamps affect the likelihood that subjects consume at least the daily-recommended 20 grammes of fibre. The OLS regression without controls finds a 7.6 percentage point reduction in the probability of reaching that threshold, while the addition of controls and matching reduce that number to 4.6 and 4.9 percentage points, respectively. The 4.9 percentage point reduction from the matching estimator represents an approximate 18 per cent reduction relative to the sample mean of subjects who consume at least 20 grammes.

In sum, the numbers in Table 5 point to three conclusions. First, food stamps appear *not* to alter total calorie intake. Second, food stamps appear to cause relatively sizable reductions in fibre intake, whether measured in total fibre, fibre grammes per calorie, or the probability of reaching the recommended 20-gramme threshold. Third, food stamp enrolment does not appear to be endogenous with respect to calorie and fibre intake, as evidenced by the similarity of estimates obtained from OLS (with controls) and matching. That finding corroborates evidence of lack of selection bias from earlier studies that employed Heckman-type models (Butler, *et al* 1985; Devaney and Moffitt 1991; Butler and Raymond 1996).

5. Why do food stamps reduce fibre intake?

The previous section presents evidence that food stamps reduce fibre intake. One the one hand, it seems difficult to fathom that receiving food stamps, which is tantamount to an increase in income, would translate to less fibre. Such a relationship would imply that, all else equal, fibre is an *inferior* good, defined as a good that experiences a fall in consumption as incomes rise. But certain fibre-rich foods *might* be inferior, and consumption of certain low-fibre foods *might increase* as incomes rise, in which case food stamps could lead to lower fibre intake, even if reduced fibre consumption is not the intent of participants. This section explores two possible ways in which food stamps might push subjects toward lower-fibre foods.

First, a long-running concern about food stamps is that recipients might use them to purchase food from fast food and pizza establishments. Previous research has explored differences in fibre intake at-home and away-from-home (Nayga 1996), so the concern is that increased consumption from fast food/pizza restaurants could lead to lower fibre consumption. In response to such concerns, the USDA implemented new restrictions that, beginning in 2017, forbade retailers from accepting food stamps if they receive more than 15 per cent of their sales from hot food, or if a fast food chain operates under the same roof. (See, 'Store Accepting Food Stamps Face Stricter Rules', Wall Street Journal, June 28, 2016.) But regardless of such restrictions, purchasing power is, to some extent, fungible across consumption categories. Therefore, food stamps might free up a family's budget such that, whether using food stamps or not, the family might consume more fast food and pizza.

Fortunately, the NHANES records a person's number of meals from fast food or pizza establishments during the past seven days. The first column of Table 6 presents estimates from regression-based and matching estimators, identical to those described in Section 3, with the dependent variable measuring the number of meals from fast food/pizza restaurants during the past seven days. None of the estimates finds a statistically-significant effect of food stamp enrolment, casting doubt as to whether increased fast food/pizza consumption explains reduced fibre intake.

Another possibility is that, as food budgets increase from receiving food stamps, families might buy fewer foods long associated with low-income diets that *also* happen to be rich in fibre. Most famously, beans and rice are two fibre-rich foods that have long been associated with low-income diets (Block *et al* 1995). If purchases of beans and rice fall as incomes rises, as seems possible, then fibre intake could fall as well.

In addition to information on nutrient intake, the NHANES also records detailed information on specific foods, using uniformly-defined USDA codes, consumed during the past 24 hours. Two of those codes closely link to beans and rice: (1) legumes (USDA code 41) and (2) pasta/rice (USDA code 56). Using that information, the last two columns in Table 6 estimate the effect of food stamps on the numbers of servings in those two categories consumed during the past 24 hours. Focusing on the matching estimates, food stamps appear to lead to 0.12 fewer servings of legumes, which represents an approximate 50 per cent reduction relative to the sample mean of 0.23 servings. And food stamps lead to 0.08 fewer servings of pasta/rice, which represents a 30 per cent reduction relative to the sample mean of 0.28 servings. The implication is that food stamps, which operate, loosely speaking, as an increase in income, push individuals away from foods long associated with lower-income diets, but those foods also happen to be relatively rich in fibre.

Table 6: Effect of food stamps on recent dietary behaviour

	Number of meals from fast food/pizza places during past seven days	Servings of legumes during past 24 hours	Servings of pasta/rice during past 24 hours
OLS (no controls)	0.135	–0.114**	–0.064**
	(0.086)	(0.018)	(0.021)
OLS (controls)	–0.104	–0.094**	–0.042*
	(0.086)	(0.019)	(0.022)
Propensity score match	–0.031	–0.116**	–0.083**
	(0.127)	(0.029)	(0.032)

* significant at .10 level
** significant at .05 level
Standard errors in parentheses.

(Regarding the OLS estimates reported in Table 6, the dependent variables in all three columns record non-negative discrete integers, often modelled using formal count regressions (Cameron and Trivedi 2013). However, Table 6 opts for simple OLS models to facilitate comparison with the matching estimators, which, unlike regression setups, do not impose distributional restrictions on dependent variables. Most importantly, the same basic conclusions emerged from more elaborate count regression setups.)

6. Conclusion

With more than 45 million enrolees in 2015, at an average of $126.83 per person per month, the food stamp programme represents one of the government's largest safety net operations. Because it directly targets eating patterns, policymakers need a good understanding of whether the programme adversely affects dietary behaviour. Moreover, due to the high likelihood that food stamp participants also enrol in public health insurance programmes, such as Medicaid, the topic also has important implications for public health and government finance. With those motivations, this paper examines the impact of food stamps on fibre intake, using data from the National Health and Nutrition Examination Study (NHANES), and a matching estimator to address possible endogeneity of food stamp participation with respect to dietary behaviour.

Results point to several main conclusions. First, food stamps appear to reduce fibre intake by approximately 11 per cent, whether measured as total fibre intake, or grammes of fibre per calorie consumed. Food stamps also reduce the probability of reaching the daily recommended threshold of 20 grammes of fibre by 18 per cent. But why do food stamps reduce fibre intake? Increased consumption from fast food/pizzas establishments does *not* appear to explain reduced fibre intake. Rather, the reason seems to be that food stamp enrolees consume 50 per cent fewer servings of legumes (beans) and 30 per cent fewer servings of pasta/rice. Those foods, long associated with low-income diets, also happen to be rich in fibre.

The USDA has acknowledged that food stamp recipients might make poor dietary decisions (Guthrie *et al* 2007). Policy makers have considered implementing nutritional education programmes to guide food stamp participants toward healthier choices (Cason *et al* 2002), while other researchers have suggested harnessing insights from the literature on behavioural economics to possibly steer enrolees toward improved dietary patterns (Mancino and Andrews 2007). Whatever remedies might exist, if improved dietary patterns among food stamp recipients lead to increased fibre consumption, then such remedies might help put a dent in problems associated with obesity and heart disease.

Accepted for publication: 20 March 2023

Endnote

1. Department of Economics, Western Kentucky University, 427 Grise Hall, Bowling Green, KY 42101, david.zimmer@wku.edu. The author gratefully acknowledges valuable comments provided by the editor and an anonymous referee.

References

Andreyeva T, Tripp A and Schwartz M (2015) 'Dietary quality of Americans by Supplemental Nutrition Assistance Program participation status', *American Journal of Preventive Medicine*, 49, 594-604.

Basiotis P, Kramer-LaBlanc C and Kennedy E (1998) 'Maintaining nutrition security and diet quality: the role of the food stamp program and WIC', *Family Economics and Nutrition Review*, 11, 4-16.

Baum C (2011) 'The effects of food stamps on obesity', *Southern Economic Journal*, 77, 623-651.

Block G, Norris J, Mandel R and DiSogra C (1995) 'Sources of energy and six nutrients in diets of low-income Hispanic-American women and their children: quantitative data from NHANES, 1982-1984', *Journal of the American Dietetic Association*, 95, 195-208.

Butler J, Ohls J and Posner B (1985) 'The effect of the food stamp program on the nutrient intake of the eligible elderly', *Journal of Human Resources*, 20, 405-420.

Butler J and Raymond J (1996) 'The effect of the food stamp program on nutrient intake', *Economic Inquiry*, 34, 781-798.

Cameron A and Trivedi P (2005) *Microeconometrics: Methods and Applications*. New York NY: Cambridge U P.

Cameron A and Trivedi P (2013) *Regression Analysis of Count Data*, 2e, New York NY: Cambridge U P.

Cason K, Cox R, Burnie J, Poole K and Wenrich T (2002) 'Do food stamps without education improve the nutrient intake of recipients?', *Topics in Clinical Nutrition*, 17, 74-82.

Devaney B and Moffitt R (1991) 'Dietary effects of the food stamp program', *Journal of Agricultural Economics*, 73, 202-211.

Dietary Guidelines Advisory Committee (2015). *Dietary Guidelines for Americans 2015-2020*, Washington DC: Government Publishing Office.

Gibson D (2003) 'Food stamp program participation is positively related to obesity in low income women', *Journal of Nutrition*, 133, 2225-2231.

Grummon A and Taillie L (2017) 'Nutritional profile of Supplemental Nutrition Assistance Program household food and beverage purchases', *American Journal of Clinical Nutrition*, 105, 1433-1442.

Guthrie J, Lin B-H, Ploeg M, and Frazai E (2007) 'Can food stamps do more to improve food choices?' US Department of Agriculture, Economic Information Bulletin Number 29-1.

Howarth N, Saltzman E and Roberts S (2001) 'Dietary fiber and weight regulation', *Nutrition Reviews*, 59, 129-139.

Kim S-Y, Nayga R and Capps O (2000) 'The effect of food label use on nutrient intakes: an endogenous switching regression analysis', *Journal of Agricultural and Resource Economics*, 25, 215-231.

Kreider B, Pepper J, Gundersen C and Jolliffe D (2012) 'Identifying the effects of SNAP (food stamps) on child health outcomes when participation is endogenous and misreported', *Journal of the American Statistical Association*, 107, 958-975.

Lustig R (2006) 'The "skinny" on childhood obesity: how our western environment starves kids' brains', *Pediatric Annals*, 35, 898-902.

Mancino L and Andrews M (2007) 'Making healthy food choices easier: ideas from behavioral economics', US Department of Agriculture, Economic Information Bulletin Number 29-7.

Meyerhoefer C and Pylypchuk Y (2008) 'Does participation in the food stamp program increase the prevalence of obesity and health care spending?' *American Journal of Agricultural Economics*, 90, 287-305.

Nayga R (1996) 'Dietary fiber intake away-from-home and at-home in the United States', *Food Policy*, 21, 279-290.

Norton E (2022) 'The inverse hyperbolic sine transformation and retransformed marginal effects', *Stata Journal*, 22, 702-712.

Pence K (2006) 'The role of wealth transformations: an application to estimating the effect of tax incentives on saving', *Contributions to Economic Analysis & Policy*, 5, article 20.

Whitmore D (2002) '*What are food stamps worth?*', Working paper 847, Department of Economics, Princeton University.

Wilde P, McNamara P and Ranney C (1999) 'The effect of income and food programs on dietary quality: a seemingly unrelated regression analysis with error components', *American Journal of Agricultural Economics*, 81, 959-971.

Yen S (2010) 'The effects of SNAP and WIC programs on nutrient intakes of children', *Food Policy*, 35, 576-583.