



ELSEVIER

Contents lists available at [SciVerse ScienceDirect](http://www.elsevier.com/locate/healthplace)

# Health & Place

journal homepage: [www.elsevier.com/locate/healthplace](http://www.elsevier.com/locate/healthplace)

## Review Essay

# Does the Food Stamp Program cause obesity? A realist review and a call for place-based research

Nathaniel L. DeBono\*, Nancy A. Ross, Lea Berrang-Ford

Department of Geography, McGill University, 805 Sherbrooke Street West, H3A 2K6, Montreal, QC, Canada

### ARTICLE INFO

#### Article history:

Received 20 June 2011

Received in revised form

3 March 2012

Accepted 5 March 2012

Available online 13 March 2012

#### Keywords:

Food Stamp Program

SNAP

Obesity

Realist review

Foodscape

### ABSTRACT

The high prevalence of obesity among low income groups has led some to question the role of food assistance programs in contributing to the problem. The USDA's Food Stamp Program (now known as the Supplemental Nutrition Assistance Program – SNAP) is the largest food assistance program in the United States with over 40 million participants. This paper employed systematic realist review methods to determine whether participation in the Food Stamp Program causes obesity and the causal pathways through which this relationship may exist. Findings indicate a more consistent positive relationship for women than for men, especially for women who are long term users of the program. All studies discussed the “food stamp cycle” and an “income effect” as explanations for the role of food stamps in increased obesity yet evidence for these factors is limited. Curiously, the research in this field does not address obesogenic environments and we suggest that the absence of an understanding of household behavior in local contexts is a significant impediment to the reform of the Food Stamp Program.

© 2012 Elsevier Ltd. All rights reserved.

## 1. Introduction and background

The prevalence of overweight and obesity in the United States has become a leading public health concern. In 2007–2008, the adult age-adjusted prevalence of obesity was 33.8% in the U.S. population (Flegal et al., 2010). Estimates indicate that 32.2% of the adult male and 35.5% of the adult female population is obese, and the prevalence of obesity among men has increased by 4.7 percentage points from 1999 to 2007 (Flegal et al., 2010). The high prevalence of obesity is of concern given that obesity is associated with many serious health conditions including diabetes mellitus, cardiovascular disease, hypertension, stroke, sleep apnea and non-alcoholic fatty liver disease (Ogden et al., 2007; Must et al., 1999). Obesity in adulthood is also associated with reduced quality of life, social stigmatization, and discrimination (Carr and Friedman, 2005).

The rising prevalence of obesity in the United States has drawn attention to disparities in obesity burden between groups of varying socioeconomic status (Wang and Beydoun, 2007). Several authors have observed that low income women are more likely to be obese than their higher income counterparts, although this relationship is less consistent for men (McLaren, 2007; Ross et al., 2007; Zhang and Wang, 2004). This phenomenon has led researchers to question why a problem of excess food consumption disproportionately affects those with the least financial

resources (Dinour et al., 2007). The USDA's Food Stamp Program<sup>1</sup> (FSP) is the largest food assistance program in the United States and has been implicated in exacerbating the health burden of obesity on its participants. Data from the National Health and Nutrition Examination Survey (NHANES) in 1988–1994 showed that adult FSP participants were significantly more likely to be obese than income eligible non-participants across all age groups (Fox and Cole, 2004). It has been argued that the FSP is an in-kind program and that benefits provided by the program smooth out household income and free up scarce household resources for other expenses (Evanson et al., 1999). FSP benefits could therefore be considered effective income and, even in the absence of a cash-transfer, could potentially reduce obesity among low income FSP participants as consistent with the income–obesity relationship (McLaren, 2007; Ross et al., 2007; Zhang and Wang, 2004). The idea that FSP participants, who effectively become wealthier through program benefits, exhibit greater obesity rates is paradoxical and strengthens the need for a critical review.

Several studies have investigated the relationship between the FSP and obesity with mixed results (Townsend et al., 2001; Jones and Frongillo, 2006; Baum, 2007; Zagorsky and Smith, 2009; Fan, 2010; Leung and Villamor, 2011). Some have established a link between FSP participation and increased bodyweight, however, many studies vary in terms of the magnitude of the observed effect. The proposed link between the FSP and obesity has also

\* Corresponding author. Tel.: +15148350261.

E-mail addresses: [nathaniel.debono@mail.mcgill.ca](mailto:nathaniel.debono@mail.mcgill.ca), [nathan.debono@gmail.com](mailto:nathan.debono@gmail.com) (N.L. DeBono).

<sup>1</sup> The “Food Stamp Program” was renamed as the “Supplemental Nutrition Assistance Program” in 2008. The original name is used here in order to maintain consistency with the reviewed literature.

been observed to vary across different demographic groups and in particular between male and female participants (Chen et al., 2005; Gibson, 2003; Ver Ploeg et al., 2007; Meyerhoefer and Pylypchuk, 2008). A previous review on this subject was conducted by Ver Ploeg and Ralston (2008). Their review highlights key methodological issues in conducting research on the FSP and obesity, including issues relating to measurement and selection bias. They conclude that for men, the use of food stamp benefits does not result in an increase in either BMI or the likelihood of being obese. For women, they conclude that participation in the FSP may increase BMI and the probability of obesity with some differential effects by race. This review builds on the work of Ver Ploeg and Ralston (2008) in light of new research published since 2008.

The purpose of this review is to investigate whether participation in the FSP contributes to obesity in adults. This review will synthesize the empirically-based academic literature that addresses this topic using a systematic search strategy and the methods of a realist review. Specifically, this review aims to: (1) evaluate whether participation in the USDA's FSP contributes to obesity in non-elderly adult men and women, and (2) identify pathways through which FSP participants may be at higher risk of obesity compared to non-participants of a similar socioeconomic status. A realist perspective on this topic challenges us to focus our attention on the pathways through which FSP participation may lead to obesity.

### 1.1. The Food Stamp Program

The USDA's FSP is the largest food and nutrition assistance program in the U.S. (USDA (U.S. Department of Agriculture), 2010d).<sup>2</sup> The current FSP began with the federal Food Stamp Act of 1964, although smaller variations of the program have existed since 1933 (Landers, 2007). Eligibility for the program today is determined by the household assets (< \$2000), gross household income (< 130% of federal poverty line), immigration status, and employment status of individuals who choose to apply (USDA (U.S. Department of Agriculture), 2011a). Between 1971 and 1974, the FSP served between 9.3 and 12.8 million participants annually, but this number has since grown to 40.3 million as of 2010 (USDA (U.S. Department of Agriculture), 2011b). The average amount of monthly benefits distributed per individual in 2010 was approximately \$134, at a total cost of \$64.7 billion to the U.S. government (USDA (U.S. Department of Agriculture), 2011b). In the fiscal year 2009, 48% of FSP participants were children. Working age women represented 28% of the caseload compared to working age men who comprised of 16%. The remaining 8% of FSP participants were aged 60 and older (USDA (U.S. Department of Agriculture), 2010c).

## 2. Methods

A systematic literature review uses replicable methods to identify, analyze, and critically appraise all relevant research on a given topic (Tricco et al., 2009). The realist method of inquiry builds on the conventional systematic review template to provide a more explanatory rather than judgmental focus (Pawson et al., 2005). Realist review holds that the underlying causal mechanism

<sup>2</sup> Monetary benefits in the FSP are administered to households through Electronic Benefit Transfer (EBT) cards, which can be used like debit cards at approved grocery stores. FSP benefits can be used to purchase any bread, cereal, fruit, vegetable, meat, fish or dairy product (USDA (U.S. Department of Agriculture), 2010b). The list of allowable items includes snack foods, soft drinks and candy, but excludes alcohol, tobacco, medicine, non-food items and hot foods prepared in-store.

and the context within which a relationship occurs must be understood in order to infer a causal outcome between two events. The realist review method is valuable when seeking to determine how and why a particular phenomenon is occurring rather than whether or not it occurs (Pawson et al., 2005). In this way, realist review approaches borrow from realist philosophy in human geography and the broader social sciences in its focus on understanding conditions and contingencies of causal relationships (Cloke et al., 1991).

### 2.1. Search strategy

The first phase of the search strategy consisted of a search of the Web of Knowledge and PubMed online article databases in November of 2010 (Fig. 1). The search consisted of the following terms within the "title" search field: "food stamp\*" OR "nutrition\* assistance". The latter term was chosen to include any title referring to nutritional assistance programs in general and to account for the renaming of the FSP in 2008. There were no date restrictions on the results of the search. The first phase of the search yielded 696 papers, of which 646 were excluded due to irrelevance and application of exclusion criteria. The second phase of the search strategy began once the database search results had been reduced to 10 relevant articles based on a predetermined set of exclusion criteria. The reference lists of all 10 articles were examined and yielded an additional two articles. Articles found through this method were subject to the same exclusion criteria after their full texts had been read.

### 2.2. Inclusion and exclusion criteria

The main exposure and outcome of interest for studies included in the review was participation in the FSP and changes in body mass index (BMI). Studies that focused on other food assistance programs were excluded. Articles investigating the impact of the FSP on weight gain exclusively in the elderly, children or in adolescents were excluded from the review (Table 1). Studies using the National Longitudinal Survey of Youth (NLSY) were included if the sampled individuals were adults for a significant majority of the period of study.

### 2.3. Data extraction

The realist review method requires a synthesis of theoretical understandings of how the FSP may be linked to obesity and of empirical evidence that either contradicts or supports such a claim (Pawson et al., 2005). Postulated theories of causal pathways and contextual influences were also analyzed in keeping with the realist approach. Information on study design, data set, statistical modeling, control for confounding factors and results was extracted and analyzed. The critical appraisal of each study was guided using the checklist for public health research outlined by Heller et al. (2007).

## 3. Results

The search strategy and inclusion/exclusion criteria yielded 13 studies that were included in the review (Table 2). The studies range in publishing date from June 2001 to July 2010. All of the studies are observational but vary in terms of their design and statistical approach. One study employed a natural experiment design (Kaushal, 2007). Three of the studies are unique in that they examined the relationship between FSP participation and weight gain specifically in relation to food security (Townsend et al., 2001; Jones and Frongillo, 2006; Webb et al., 2008). Information on height and weight was self-reported in all studies

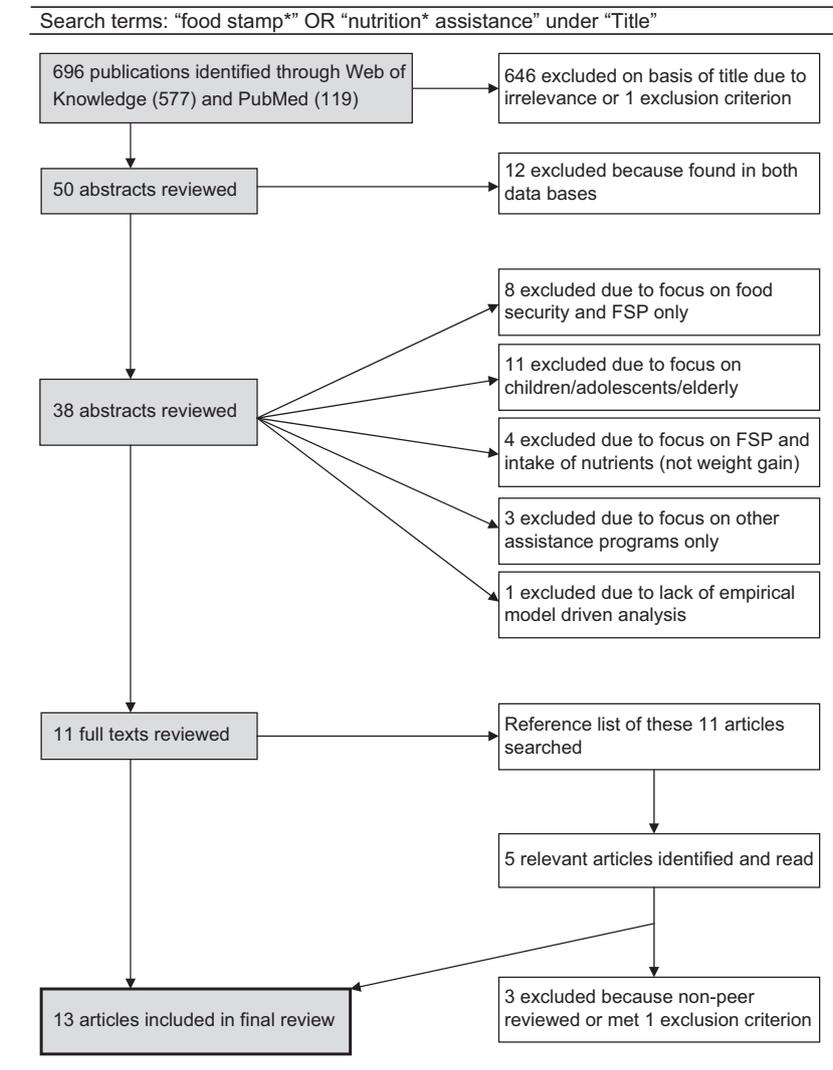


Fig. 1. Methodology of search and inclusion/exclusion.

Table 1  
Inclusion and exclusion criteria.

| Inclusion  | Exclusion   |
|--|---|
| Food Stamp Program                                     | Food security not in relation to FSP and obesity  |
| Supplemental Nutrition Assistance Program (SNAP)       | Women Infants & Children Assistance Program or other Nutritional/obesity education programs |
| Investigates relationship b/w FSP and weight gain only | Focuses on children/adolescents/elderly only  |
| FSP participant behaviors                              | General risks of obesity/diet   |
| Focuses predominantly on non-elderly adults            | Food stamping (i.e., food processing)   |
| Empirical model-driven analysis                        | Non-peer reviewed   |
| Published up to November 10th 2010                     |   |
| Peer-reviewed  |   |

except for Ver Ploeg et al. (2007) which used the NHANES data set. Five studies using self-reported data on BMI made adjustments to account for reporting bias (Baum, 2007; Zagorsky and Smith, 2009; Fan, 2010; Kaushal, 2007; Townsend et al., 2001).

### 3.1. Determining cause and effect

The FSP is an entitlement program in that eligible individuals choose whether or not they wish to apply and participate in the program. Only 66% of eligible individuals in 2008 actually received food stamps, and therefore studies must account for

the selection bias that may occur as a result of factors that influence an individual's decision to participate in the FSP (USDA (U.S. Department of Agriculture), 2010d; Frongillo, 2003). Selection bias can confound results if there are unobserved factors that affect both the decision to participate in the FSP and the BMI of individuals. For example, food security has been linked to obesity as food insecure individuals lack access to healthy foods, but may also contribute to the decision to participate in the FSP in order to make food more financially accessible (Dinour et al., 2007; Townsend et al., 2001). FSP participation may therefore be a proxy for food insecurity.

**Table 2**  
Summary of studies included in review.

| Authors                          | Design                   | Data set <sup>a</sup><br>(years sampled) | Findings   | Control for:  |  | Posited causal pathways   |
|----------------------------------|--------------------------|--|--|---------------|--|---|
|                                  |                          |  |  | Food security | Selection bias <sup>b</sup>                          |   |
| Townsend et al. (2001)           | Cross-sectional          | CSFII (1994–1996)                        | <i>Women:</i> FSP associated with 38% higher likelihood of overweight (BMI > 27.3) <i>Men:</i> no significant effect   | Yes           | No   | Food stamp cycle, women more often head of household with children  |
| Gibson (2003)                    | Longitudinal             | NLSY 1979 (1985–1996)                    | <i>Women:</i> current FSP associated with 9.1% increase in obesity risk, 5-year FSP associated with 20.5% increase <i>Men:</i> no significant effect   | No            | Fixed effects  | Food stamp cycle, depression, stress induced biological changes, propensity to purchase energy dense food, income effect          |
| Chen et al. (2005)               | Cross-sectional          | CSFII (1994–1996)                        | <i>Women:</i> FSP associated with 3.6 unit increase in BMI <i>Men:</i> no significant effect   | No            | Joint probit model                                   | Income effect, propensity to purchase energy dense food, differing male/female energy needs                                       |
| Gibson (2006)                    | Longitudinal             | NLSY 1979 (1986–2000)                    | <i>Women (mothers):</i> long term (> 5 yrs) FSP not associated with obesity in mothers only, but is significantly associated with simultaneous obesity in mothers and overweight in daughters <i>Men:</i> not studied              | No            | Fixed effects  | Any causal pathway between the FSP and weight gain will have to simultaneously influence daughter overweight and maternal obesity |
| Jones and Frongillo (2006)       | Longitudinal             | PSID (1999–2001)                         | <i>Women:</i> FSP offset overall weight loss with a 0.8 kg weight gain per year in food insecure women; no effect in food secure <i>Men:</i> not studied   | Yes           | Lagged and dynamic models                            | Food stamp cycle, propensity to purchase energy dense food, psychological effect of long-term poverty/stress                      |
| Ver Ploeg et al., 2007           | Multiple cross-sectional | NHANES (1976–1980, 1988–1994, 1999–2002) | <i>Women:</i> FSP more likely to be obese in first two waves only compared to income eligible non-participants <i>Men:</i> no significant difference in BMI between FSP and eligible non-participants in most waves                | No            | No   | Food stamp cycle, income effect, propensity to purchase energy dense food, more meals consumed away from home                     |
| Kaushal (2007)                   | Natural experiment       | NHIS (1992–2001) and CPS (1994–2002)     | <i>Women:</i> foreign-born women who continued with FSP had a statistically insignificant 0.3 unit greater BMI compared to those who ceased <i>Men:</i> no significant effect  | No            | DID, IV models                                       | Food stamp cycle, income effect, propensity to purchase energy dense food   |
| Baum (2007)                      | Longitudinal             | NLSY 1979                                | <i>Women:</i> current FSP associated with a 2–5 percentage point rise in obesity risk, 2-year FSP associated with 10 percentage point increase <i>Men:</i> 2 year FSP associated with 15 percentage point increase in obesity risk | No            | Fixed effects, lagged, dynamic, hazard and IV models | Food stamp cycle, income effect, propensity to purchase energy dense food   |
| Meyerhoefer and Pylypchuk (2008) | Longitudinal             | MEPS (2000–2003)                         | <i>Women:</i> FSP associated with a 6.7% increase in obesity risk <i>Men:</i> no significant effect  | No            | IV and ordered probit (discrete factor model)        | Income effect, propensity to purchase energy dense food   |
| Webb et al. (2008)               | Cross-sectional          | State phone survey                       | <i>Men and Women:</i> FSP within past year associated with 3 unit increase in BMI  | Yes           | No   | Food stamp cycle, income effect, propensity to purchase energy dense food   |
| Zagorsky and Smith (2009)        | Longitudinal             | NLSY 1979 (1981–2002)                    | <i>Women:</i> FSP associated with a 1.24 unit increase in BMI, <i>Men:</i> no significant effect   | No            | No   | Food stamp cycle, income effect, propensity to purchase energy dense food, neighborhood poverty, depression                       |
| Fan (2010)                       | Longitudinal             | NLSY 1979 (1985–1994)                    | <i>Women:</i> no significant effect, <i>Men:</i> not studied   | No            | DID PSM model  | Food stamp cycle, income effect, propensity to purchase energy dense food   |
| Leung and Villamor (2011)        | Cross-sectional          | CHIS (2007)                              | <i>Women:</i> no significant effect, <i>Men:</i> FSP associated with 2.5 unit increase in BMI  | Yes           | No   | Food stamp cycle, propensity to purchase energy dense food, more meals away from home, intra-household food allocation            |

<sup>a</sup> Continuing Survey of Food Intakes by Individuals (CSFII), National Longitudinal Survey of Youth 1979 (NLSY), Panel Study of Income Dynamics (PSID), National Health and Nutrition Examination Surveys (NHANES), National Health Interview Survey (NHIS), Current Population Survey (CPS), California Health Interview Survey (CHIS).

<sup>b</sup> Difference-in-differences (DID), Instrumental Variable (IV), Propensity Score Matching (PSM).

Claims of causality between FSP participation and obesity must also be particularly sensitive to directionality. Each of the reviewed studies aimed to investigate whether FSP benefits cause weight gain. However, any observed association between the two variables may be subject to reverse causality (Gibson, 2003). Obesity may cause participation in the FSP since heavier individuals have greater caloric requirements and may thus have an increased need for food stamps in order to purchase a larger amount of food. Obesity may also reduce the economic chances of individuals (through workplace discrimination or reduced marital opportunities) and increase the probability that they will be income eligible for food stamps (Gibson, 2003).

Cross sectional studies are significantly limited in their ability to isolate the effect of FSP participation on body weight. Both

Baum (2007) and Gibson (2003) have pointed out the inability of cross sectional studies to infer causal relationships and to account for changes in body weight and FSP participation over time. Fan (2010) suggested that the historical measurement of these two variables is important since body weight is determined by an accumulation of past behaviors and an individual's FSP participation itself varies over time with changing financial circumstance. Cross sectional surveys are also more likely to include individuals who have been participating in the FSP for longer rather than briefer periods, potentially biasing the results toward this group (Ver Ploeg et al., 2007). Several of the cross sectional studies in this review failed to account for the BMI of individuals prior to FSP participation and therefore any association may be a reflection of reverse causality from obesity to the FSP (Webb et al., 2008;

Townsend et al., 2001; Leung and Villamor, 2011; Ver Ploeg et al., 2007).

### 3.2. Cross sectional studies

Ver Ploeg et al. (2007) determined the long-term trends in the BMI of FSP participants versus individuals who are income eligible but not participating in the program. They examined three waves of the NHANES beginning in 1976–1980 and ending in 1999–2002. Their results from the first wave indicate that the mean BMI of female FSP participants (27.5) was one unit higher than income-eligible non-participants (26.5), however, this weight disparity disappeared by the final survey wave in 2002 as the BMI's of the non-participating population caught up to those women participating in the FSP. For black women, there were no significant differences between the participating and eligible non-participating groups for all three of the survey waves. The association between FSP participation and obesity was less clear for men. The mean BMI of white FSP participants was not significantly different than those of the eligible or high income non-participants except during the most recent wave, where non-participants had a significantly higher BMI than FSP participants.

The results of Ver Ploeg et al. (2007) demonstrate that women have been gaining weight regardless of participation in the FSP and that the BMI of non-participating groups have gradually caught up to those receiving FSP benefits. Ver Ploeg et al. (2007), however, do not provide an understanding of the degree to which the FSP explains differences in weight between groups relative to overall secular trends.

### 3.3. Cross sectional studies with controls for selection bias

Webb et al. (2008) and Leung and Villamor (2011) used state-level population data in Massachusetts and California with information on the food security status of sampled individuals. Leung and Villamor (2011) found that male FSP participants had a 2.5 unit greater BMI and 61% higher likelihood of obesity compared to eligible non-participants. Female FSP participants did not have a significantly different BMI than eligible non-participants. Webb et al. (2008) found that participation in the FSP was associated with a 3.0 unit increase in BMI in adults. Webb et al. (2008) achieved a response rate of only 21.6% and did not separate their analysis by sex likely due to their small sample size. Both Leung and Villamor (2011) and Webb et al. (2008) found that the association between FSP participation and BMI was not significantly modified by food security status.

Townsend et al. (2001) utilized the nationally representative Continuing Survey of Food Intake by Individuals for their cross sectional analysis. Their models included controls for individual health behaviors (including physical activity), demographic and socioeconomic characteristics and food security status. Their findings indicate that FSP participation was significantly associated with a 38% increased likelihood of being overweight (BMI > 27.3) in women. The authors found no significant relationship between FSP program participation and overweight in men.

Townsend et al. (2001) also reported that food insecure individuals were more likely to participate in the FSP, and that there is a positive linear relationship between the level of food insecurity and BMI of women who receive food stamps. These findings indicate that food security has an interactive effect on the relationship between FSP participation and BMI, and that failure to control for food security status may introduce bias (Townsend et al., 2001). This result lies in contrast to findings by Webb et al. (2008) and Leung and Villamor (2011) who found that food security did not significantly modify their results, and may be

attributable to differences in the size and location of the populations sampled.

Chen et al. (2005) utilized the same data set as Townsend et al. (2001) but applied a statistical model that controls for selection bias into the FSP. They used a simultaneous bivariate probit model to estimate the decision to participate in the program simultaneously with body weight, in order to allow for unobserved determinants of both FSP participation and body weight to be accounted for. Chen et al. (2005) also used instrumental variable estimates to control selection bias, however, other authors have suggested that these instrumental variables may have upwardly biased their findings (Meyerhoefer and Pylypchuk, 2008). The findings of Chen et al. (2005) indicate that FSP participation is associated with a 3.6 unit rise in BMI among income eligible women. They found no significant relationship among men.

### 3.4. Longitudinal studies

Zagorsky and Smith (2009) utilized NLSY to model the effect of FSP participation on BMI with controls for a host of socioeconomic and demographic characteristics. They found that female FSP participation explained a 1.24 unit increase in BMI compared to non-participants, but had no significant effect for men. Their results show a difference between races, in that FSP participation explained a 1.1 unit increase in BMI in black women compared to a 1.96 unit increase for white women. Zagorsky and Smith (2009) also modeled the long-term versus short-term effects of FSP participation, and found that the average duration of FSP participation of 7.4 years in their sample predicted an additional BMI increase of 0.32 units in women.

Zagorsky and Smith (2009) did not control for food security nor selection bias in their analysis. However, they included a variable for county median income into their model in order to control for the effects of local area poverty on the relationship between FSP participation and BMI. Regressions based solely on respondent's characteristics may neglect neighborhood factors that could confound the results such as the availability of food retailers and facilities for physical activity (Baum, 2007; Zagorsky and Smith, 2009). They also modeled the relationship between BMI and FSP participation in adults (both men and women combined) for the years prior to, during, and after a period of receiving benefits. Their results indicate that the BMI of individuals increased by 0.07 units each year prior to participation in the FSP, and increased by 0.4 units per year during their participation in the program. After leaving the program, the rate of weight gain dropped to 0.2 units per year.

### 3.5. Longitudinal studies with controls for selection bias

Jones and Frongillo (2006) aimed to determine any moderating effect of FSP benefits on the body weight of food insecure women. They modeled their results using lagged and dynamic regression models that estimated the effect of changing FSP participation and changing food security status on subsequent changes in BMI. Their models also controlled for BMI prior to FSP participation. The results of Jones and Frongillo (2006) indicate that FSP participation increases weight gain among persistently food insecure women by 0.8 kg per year. Full time participation in the FSP was not associated with weight gain in women who were food secure or moderately insecure or whose food security status changed over the survey period. Gibson (2006) investigated the effect of long term FSP participation on weight gain in mothers and their daughters (4.5–11.5 years old) in order to elucidate causal pathways operating at the household, rather than the individual, level. Using fixed effects models, their results indicate that long term FSP participation is not associated with obesity in

mothers only (i.e., when their daughters are not also overweight/obese), but is significantly associated with simultaneous obesity in mothers and overweight in daughters.

Gibson (2003), Baum (2007) and Meyerhoefer and Pylypchuk (2008) each used longitudinal data and attempted to account for selection bias by controlling for unobserved time-invariant factors that may influence an individual's decision to participate in the FSP, such as genetic predisposition to obesity and health endowment in childhood. Meyerhoefer and Pylypchuk (2008) utilized an ordered probit model for their analysis with instrumental variable estimates to control for selection bias. Gibson (2003) and Baum (2007) both utilized the NLSY 1979 data set and performed fixed effects modeling. Baum (2007) also conducted lagged, dynamic, hazard, and instrumental variable estimates in order to account for selection bias and an individual's BMI prior to enrollment in the FSP. Meyerhoefer and Pylypchuk (2008) found that female FSP participants are 5.9% more likely to be overweight and 6.7% more likely to be obese than income eligible non-participants. They found no significant effect of FSP participation in men. Gibson (2003) found that among income eligible women, current participation in the FSP was associated with a 9.1% increase in the predicted probability of obesity. They also measured the effects of long-term participation in the FSP, and found that 5 year participation was associated with a 20.5% increase in the predicted probability of current obesity compared to eligible non-participants over the same time period. Gibson (2003)'s results however may be upwardly biased or subject to reverse causality as they did not account for participant's BMI prior to enrollment in the program. The results of Baum (2007) indicate that current FSP participation increases the risk of obesity by 2–5 percentage points in women, and that 2 year participation in the program increased this risk to 10 percentage points relative to eligible non-participants. For men, current FSP participation was not significantly associated with an increased obesity risk, however 2 year participation was associated with a 15 percentage point increased risk.

Kaushal (2007) and Fan (2010) employed a difference-in-differences model in order to investigate the relationship between the FSP and obesity and both claimed similar findings. Kaushal (2007) analyzed a natural experiment whereby the federal Personal Responsibility and Work Opportunity Reconciliation Act in 1996 denied FSP benefits to legal immigrants and restricted participation in the FSP to U.S. citizens only. Several states implemented substitute programs for immigrant populations, thereby creating a random change in FSP participation that was unrelated to the BMI of individuals. Kaushal (2007) used a difference-in-differences model to estimate the difference in changes in BMI and to control for unobserved confounding factors that vary over time. Kaushal (2007)'s results indicate that foreign-born women who continued to receive FSP benefits after the legislation had a mean BMI 0.3 units higher than those who ceased receiving benefits, however this result was not statistically significant. Kaushal's (2007) results also lack external validity since the findings for the immigrant population may not generalize to U.S.-born citizens.

Fan (2010) utilized the NLSY 1979 data set similar to Gibson (2003), Baum (2007), and Zagorsky and Smith (2009), however restricted their analysis to women only. Fan (2010) established treatment and comparison groups according to full time participation in the FSP and income-eligibility. Fan (2010) employed a difference-in-differences propensity score matching technique in order to estimate the effect of FSP participation on BMI. The covariates that Fan (2010) uses to calculate each individual's propensity score include pre-participation BMI and a variety of socioeconomic and demographic factors. Using a sample size similar to those of Gibson (2003) and Baum (2007), Fan's (2010)

results show that neither one year nor three year participation in the FSP has a significant effect on the BMI of women.

The use of the difference-in-differences matching technique controls for selection into the FSP since it does not rely on specific parametric assumptions on outcome (Gibson-Davis and Foster, 2006). However, implicit in propensity score matching is the assumption that all factors relating to self-selection into the treatment are observed and measured (Gibson-Davis and Foster, 2006). Fan (2010) did not include employment status, occupation, weeks worked in the past 12 months and working hours per week as covariates in the estimation of their propensity scores. Employment status and the intensity of an individual's work week has been shown to be one of the largest predictors of FSP participation (as the decision to receive FSP benefits is often motivated by a reduced financial circumstance), in addition to influencing an individual's energy balance and BMI (Kaiser, 2008; Baum, 2007; King et al., 2000; Choi et al., 2010). Fan (2010)'s results should therefore be interpreted with caution given that the propensity scores were estimated without observations of employment characteristics, and could potentially explain the difference in results with Gibson (2003) and Baum (2007).

### 3.6. Causal pathways for weight gain in Food Stamp Program participants

An understanding of the causal pathways through which the receipt of FSP benefits can promote energy imbalance is necessary in order to be convinced of any associations observed at the population level. Each of the reviewed studies refers to the "food stamp cycle" and the "income effect" as two main pathways through which food stamps are theorized to promote energy imbalance. The food stamp cycle refers to the fact that FSP benefits are administered in single lump sums at the beginning of each month (Townsend et al., 2001). The majority of FSP recipients conduct the bulk of their grocery shopping within the first week after receiving their benefits (Wilde and Ranney, 2000). Recipients tend to overeat shortly after their benefits are administered, and then restrict their food intake later in the month as their benefit amount becomes depleted. Shapiro (2005) observed that FSP recipient's mean daily caloric intake declined by 10–15% over the course of each month in between the receipt of benefits. It has been suggested that a cycle of successive binge eating followed by periods of caloric deprivation can alter metabolism in ways that promote fat storage and accumulation (Yanovski, 2003). No known study to date however has directly tested whether changes in the frequency of benefit distribution has any effect on subsequent changes in BMI.

The income effect describes the tendency of FSP participants to increase their expenditure on food. The reviewed studies commonly cite evidence by Fraker et al. (1986), who conducted a review of the literature to determine whether FSP recipients have an increased propensity to purchase food using benefits rather than cash income. They concluded that FSP participants spend between 17 and 47 cents more on food per dollar of benefits compared to an equivalent amount of cash. The fact that food stamps increase an individual's food expenditure does not necessarily indicate that they are consuming an increased amount of calories. It is possible that participants may be purchasing higher quality foods that cost more.

Research on the food choices of FSP participants however does not support the notion that recipients use their benefits to purchase nutritious foods. Leung and Villamor (2011) was the only study included in the review that sampled the dietary choices of FSP participants. Leung and Villamor (2011)'s mean adjusted estimates indicate that FSP participants consumed soft drinks 7.9 and fruit 3.8 times per week compared to 5.7 and

4.3 times per week in income eligible non-participants. Leung and Villamor's (2011) findings are consistent with supporting literature that has investigated the dietary patterns of FSP participants. A cash-out experiment in San Diego indicated that among FSP households whose benefit amount was lower than their usual shopping budget, 15% of FSP participants consumed more than twice their recommended daily caloric intake compared to only 11% of participants who were given cash instead. This effect was observed only in San Diego, and not in an identical experiment in Alabama (Schanzenbach, 2002). Wilde et al. (1999) analyzed the diet composition of FSP participants and found that they consume significantly more meat, added sugars and total fat than other individuals with a similar income. Zhang et al. (2011) found that differences in county-level food prices modifies the effect of food stamps on the BMI of female participants, suggesting that low prices for unhealthy foods may be one pathway through which participants may be consuming excess calories.

The reviewed studies do not provide a thorough examination of why the FSP–obesity relationship differs between men and women. Socio-behavioral explanations for the gender difference posit that men are more likely to engage in physically intensive, manual labor occupations and therefore are robust to any increased caloric intake caused by participation in the FSP (Townsend et al., 2001). Women may also be more likely than men to consume food as a coping mechanism for depression or adverse life events (Chen et al., 2005). These hypotheses lack supporting evidence in relation to the FSP and remain untested.

Differences in FSP participation rates between men and women provide more substantive evidence. Baum's (2007) findings indicate that women are significantly more likely to be long-term participants in the FSP, with over 50% of female participants receiving benefits for longer than 2 years. In contrast, men are more likely to be short term (< 9 months) participants in the FSP as opposed to receiving benefits in the medium or long-term. As findings from Baum (2007), Gibson (2003), and Zagorsky and Smith (2009) suggest, long-term FSP participation is more likely to be associated with increased BMI. The gender difference in the FSP–obesity relationship may therefore simply be a proxy for differences in duration of participation between men and women (Baum, 2007).

## 4. Discussion

### 4.1. Relationship between food stamps and obesity in women and men

The reviewed literature investigating the role of food stamps in causing weight gain or obesity in the adult population exhibits inconsistent findings. Cross sectional studies generally find that certain FSP participants are at an increased risk of obesity; however, they are limited in their ability to control for selection bias and confounding variables (Townsend et al., 2001; Chen et al., 2005; Webb et al., 2008; Leung and Villamor, 2011).

Longitudinal studies controlling for selection bias and a range of socioeconomic and demographic characteristics generally find that food stamp receipt contributes to weight gain and obesity risk in women (Gibson, 2003; Meyerhoefer and Pylypchuk, 2008; Baum, 2007). Theoretically, if the FSP causes excess weight gain, then longer spells of participation in the program would be associated with increased risk of obesity compared to briefer spells. Additionally, spells of participation would be characterized by greater increases in BMI compared to pre- and post-participation periods. Longitudinal evidence from Gibson (2003), Baum (2007) and Zagorsky and Smith (2009) support these theories for women, although Zagorsky and Smith (2009) did not control for

non-random selection into the FSP. Fan (2010) and Kaushal (2007) were the only studies that investigated the FSP–obesity relationship over time, while controlling for selection bias, with findings that contradict those of Gibson (2003), Baum (2007), Meyerhoefer and Pylypchuk (2008).

Among men, the FSP does not have an effect on weight gain or risk of obesity. Baum (2007) and Leung and Villamor (2011) are the only two studies that found any association in men, although two studies did not include men in their analysis (Fan, 2010; Jones and Frongillo, 2006). Baum (2007) theorized that men participating in the FSP are less likely to engage in long spells of participation and are therefore less likely to be obese compared to their eligible non-participating counterparts. This hypothesis, however, was not supported by the results of Gibson (2003), who also estimated the long-term effect of FSP participation on obesity in men and found no relationship.

Explanations for the difference between male and female responses to FSP participation in the reviewed literature do not adequately address the effect of single parenthood or child rearing on the obesity risk of women. The results of Gibson (2006)'s analysis of mother and daughter FSP participants suggest that any causal pathways posited to explain obesity caused by participation in the FSP must account for simultaneous weight gain in mothers and daughters within households. Single mothers are more likely to experience chronic stress, reduced social support, and depression compared to married mothers of a similar socioeconomic status (Cairney et al., 2003; Higgins et al., 2006). In the context of FSP participation, single mothers may use their benefits to consume an excess of highly palatable foods as a coping mechanism for the psychosocial hardships of single parenthood and poverty. The presence of children in a household could also change the dynamics of food allocation and consumption for single-parent mothers (Ver Ploeg and Ralston, 2008). In resource scarce households, mothers may try to shield their children from hunger by reducing their own food intake and allocating more food to their children (Nord et al., 2007; Bhattacharya et al., 2004). The effects of the food stamp cycle on a single-mother's metabolism and energy balance would be especially strong if they allocate more food to their children as their benefits decline over the course of each month. This effect would be greater for women since women are far more likely to head single-parent households receiving food stamps than men (USDA, 2010e). It is therefore plausible that the hunger shielding or coping strategies of single mothers is a partial driver for the observed differences between men and women in the FSP–obesity relationship.

Nutrigenomics have also been posited to play a role in the observed sex differences in obesity status among FSP participants. Chen and Zhang (2011) hypothesized that unobserved genetic heterogeneities in nutritional needs, combined with the in-kind nature of the program, leads to a positive association between FSP participation and increased bodyweight among certain sub-populations. Given that FSP benefits are not allotted on the basis of individual caloric requirements, excess food consumption as a result of the FSP may affect the bodyweight of women more so than men.

Studies on the FSP–obesity relationship in adults that have been published since 2008 are generally consistent with the conclusions of the previous review by Ver Ploeg and Ralston (2008). Although, contrary to the conclusions of Ver Ploeg and Ralston (2008), Leung and Villamor (2011) found an association between the FSP and increased BMI in men but not in women. Despite new modeling approaches, no study since the previous review has succeeded in adequately isolating the effect of food stamps on obesity from other obesity-related factors and eliminating the problem of selection bias. Our review has, however, discussed new understandings regarding the causal pathways

involved in the FSP–obesity relationship relating to differences in dietary patterns and food security. Most importantly, our review highlights the need for a new approach to FSP–obesity research that tests the causal pathways involved and emphasizes the role of place as a contextual determinant of a FSP participant's obesity risk.

#### 4.2. Future research and the need for place-based neighborhood analysis

The reviewed literature has exhausted nearly all efforts at reducing selection bias and isolating the effect of the FSP on BMI while using large scale population-based surveys. Our review supports the point made by [Wilde \(2007\)](#) that additional research that takes a similar approach is unlikely to be fruitful. Two very recent studies investigating the FSP–obesity relationship have been published during the publication process of the current review, and thus were unable to be included in our formal systematic review process ([Han et al., 2011](#); [Jilcott et al., 2011](#)). Similar to previous work, the results of these studies are limited by selection bias and a lack of testing of potential causal pathways. A review by [Meyerhoefer and Yang \(2011\)](#) emphasizes the need for greater pathway research in the literature on food assistance programs and health. Future research should employ both a gender and place-based approach that focuses on the role of individuals, households, and interactions with their neighborhood environments.

The literature on neighborhood environments and diet/obesity risk offers clues for developing a better modeling approach of the FSP–obesity relationship. Neighborhood environments can affect participation in the FSP and energy balance through the availability of FSP retailers that sell healthy foods, food prices, outlets for physical activity, stigma associated with participation in the FSP, and peer networks who can share knowledge about the existence of the FSP and application procedure. Variation in the neighborhood accessibility and quality of FSP approved retailers could influence an individual's self-selection into the FSP, reduce diet quality and increase their likelihood of being overweight.

Research suggests that accessing FSP-approved supermarkets is very time consuming and costly for program participants in certain neighborhoods. Store accessibility and food prices at certain stores have been cited as major factors affecting where female FSP participants shop and the frequency of their shopping trips ([Wiig and Smith, 2009](#)). Attempts by participants to access larger food stores with a wider variety of healthy foods can be undermined by the FSP-approval criteria for retailers which permit stores that offer no fruits and vegetables, primarily energy-dense snack foods or non-food items such as alcohol the ability to accept FSP benefits<sup>3</sup>. Data from 1999 indicate that 89% of FSP recipients do most of their grocery shopping at supermarkets, however 41% of them were found to supplement food from supermarkets with purchases at convenience stores ([Ohls et al., 1999](#)). Many also reported low satisfaction with the food selection and prices at retailers in their neighborhoods. [Bhargava \(2004\)](#) reported significant positive associations between frequency of shopping trips and the intake of calcium, fiber, and beta carotene among a sample of 919 households participating in the FSP. The frequency of shopping trips was also negatively associated with dietary densities of mono- and polyunsaturated

fat, suggesting that increased accessibility to FSP-approved retailers would encourage frequent shopping trips and the purchase of fresh produce among participants in the program. Research conducted on urban food deserts in Chicago revealed that 9% of the city's FSP retailers are primarily liquor stores ([Mari Gallagher Research & Consulting Group, 2007](#)).

Additional research on neighborhood foodscapes has shown that neighborhood poverty is associated with a lack of grocery stores selling fresh produce and an over-concentration of fast food outlets ([Moore et al., 2008](#); [Gordon et al., 2011](#); [Walker et al., 2010](#)). Large chain supermarkets also locate more frequently in wealthier neighborhoods compared to impoverished ones ([Zenk et al., 2005](#); [Morland et al., 2002](#); [Powell et al., 2007](#)). The prevalence of obesity has also been shown to be lower in areas with a higher prevalence of large supermarkets ([Morland and Evenson, 2009](#)). A major theme in the literature on neighborhoods and food/obesity pertains to racial disparities in access to affordable healthy foods or diet-related disease ([D'Angelo et al., 2011](#); [Smiley et al., 2010](#); [Black et al., 2010](#)). The racial disparity in neighborhood food access represents one potential pathway to explain the higher BMI of black FSP participants observed in the reviewed studies.

Our review finds that the empirically-based literature investigating the FSP–obesity relationship does not adequately allow for an understanding of why eligible individuals do or do not decide to participate in the FSP, how their receipt of benefits affects their consumption behavior and body weight, and how their neighborhood foodscape influences these two processes. The literature on how the neighborhood foodscapes of low income individuals influences obesity risk and the research on the neighborhood-level barriers to healthy food procurement among FSP participants are highly relevant to FSP–obesity research. The understandings provided by these two groups of literature must be merged with the empirically-based studies investigating a causal relationship between the FSP and obesity. Modeling the FSP–obesity relationship should incorporate features of the neighborhood environment to overcome some of the methodological and pathway problems plaguing the studies included in our review.

Adverse neighborhood food and physical activity environments represent one pathway through which FSP participants may be placed at higher risk of obesity compared to other participants or to eligible non-participants living in a more favorable neighborhood context. Neighborhood pathways are in need of exploration in order to untangle the FSP–obesity relationship, and are likely to offer insights into how food insecurity influences any potential causal pathways. Future research should examine whether spatial disparities exist between the distribution of FSP-approved supermarkets and the neighborhoods with a higher proportion of participating households. Research focusing both on individual characteristics and neighborhood context would go further in developing a better understanding of why the relationship between the FSP and weight gain appears to be modified by sex and race. Understandings of how the neighborhood accessibility and quality of FSP retailers, in addition to influences of the neighborhood social environment (i.e., peer networks and stigma), affect the BMI of FSP participants is needed. Qualitative research involving interviews with FSP participants, as conducted by [Wiig and Smith \(2009\)](#), is well suited to provide the necessary understanding of these neighborhood level processes and would complement empirical model-based research. Research is also needed to empirically test the validity of the food stamp cycle hypothesis in relation to changes in body weight. Testing the food stamp cycle hypothesis would be bolstered by incorporating measures of neighborhood foodscapes since constraints on shopping frequency and store choice are determined in part by features of an individual's neighborhood

<sup>3</sup> The criteria for a grocery retailer to become an approved acceptor of FSP benefits are to either (1) offer at least three different varieties of food in each of the four staple food groups (bread and grains, dairy, fruits and vegetables, and meat/poultry/fish) with perishable foods in at least two categories, or to (2) have at least 50% of total revenue come from the sale of these staple foods ([USDA \(U.S. Department of Agriculture\), 2010a](#)).

environment. Incorporating these factors into research examining the FSP–obesity relationship would provide a better understanding of causal pathways involved and would be facilitated through neighborhood, as opposed to national-level analyses.

## 5. Concluding remarks

The USDA's FSP aims to reduce food insecurity and hunger in low income households. Our review suggests that there is support for obesity as an unintended consequence of the FSP program in the United States, especially for women who are long term users of the program. Our review further suggests that the mechanisms linking the FSP to obesity are poorly understood. An absence of research focus on the "why" question in this important public health domain means that reforming the FSP to act as a policy intervention against obesity poses significant challenges.

Proposed policy changes have included restricting FSP-approved grocery retailers to stores carrying a wider variety of fresh produce and more nutritious foods (Alston et al., 2009). This action would, however, come at a tradeoff with restricting the availability of food retailers for FSP participants who are almost certainly limited in their ability to access food (Wiig and Smith, 2009). The USDA could respond by regulating the spatial distribution of FSP-approved retailers to ensure that they are available and accessible in high-participant neighborhoods. Efforts to change the purchasing habits of FSP participants could be realized by expanding the list of items that cannot be purchased using FSP benefits (Alston et al., 2009). Disallowing the purchase of candy or soft drinks would also likely draw intense opposition from large food and soft drink corporations who exert substantial influence over agricultural and food policy in the U.S. The USDA already prohibits the use of funds from their SNAP-Ed nutrition education program to fund public health advertisements that discourage the consumption of soft drinks (Shenkin and Jacobson, 2010).

Other possible policy changes to the FSP could be less problematic. The introduction of mandatory nutrition education courses for FSP participants, such as the Food and Nutrition Education Program which is already offered by the U.S. government and has been linked to improved nutritional intake, could be offered to improve dietary intake and alter purchasing behaviors (Zagorsky and Smith, 2009). Rather than restricting the purchase of unhealthy foods with FSP benefits, a system of discounts and refunds can be implemented for the purchase of fruits and vegetables or nutritious foods. This action may help to provide a financial incentive for the consumption of health-promoting foods, but could also increase administrative and operating costs of the program (Alston et al., 2009; Guthrie et al., 2007).

## References

Alston, J.M., Mullaly, C.C., Summer, D.A., 2009. Likely effects on obesity from proposed changes to the US food stamp program. *Food Policy* 34 (2), 176–184.

Baum, C., 2007. The effects of food stamps on obesity. Report No. 34. United States Department of Agriculture, Washington, DC.

Bhargava, A., 2004. Socio-economic and behavioural factors are predictors of food use in the National Food Stamp Program Survey. *British Journal of Nutrition* 92, 497–506.

Bhattacharya, J., Currie, J., Haider, S., 2004. Poverty, food insecurity, and nutritional outcomes in children and adults. *Journal of Health Economics* 23, 839–862.

Black, J.L., Macinko, J., Dixon, L.B., Fryer Jr., G.E., 2010. Neighborhoods and obesity in New York City. *Health & Place* 16, 489–499.

Cairney, J., Boyle, M., Offord, D.R., Racine, Y., 2003. Stress, social support, and depression in single and married mothers. *Social Psychiatry and Psychiatric Epidemiology* 38, 442–449.

Carr, D., Friedman, M.A., 2005. Is obesity stigmatizing? Body weight, perceived discrimination, and psychological well-being in the United States. *Journal of Health and Social Behavior* 46, 244–259.

Chen, Z., Yen, S.T., Eastwood, D.B., 2005. Effects of food stamp participation on body weight and obesity. *American Journal of Agricultural Economics* 87 (5), 1167–1173.

Chen, Z., Zhang, Q., 2011. Nutrigenomics hypothesis: Examining the association between Food Stamp Program participation and bodyweight among low-income women. *Journal of Family Economic* (32), 508–520.

Choi, B., Schnall, P.L., Yang, H., Dobson, M., Landsbergis, P., Israel, L., Karasek, R., Baker, D., 2010. Sedentary work, low physical job demand, and obesity in US workers. *American Journal of Industrial Medicine* 53, 1088–1101.

Cloke, P., Philo, C., Sadler, D., 1991. Realist approaches in human geography. In: Cloke, et al. (Eds.), *Approaching Human Geography: An Introduction to Contemporary Debates*. Guildford Press, New York, NY.

D'Angelo, H., Suratkar, S., Hee-Jung, S., Stauffer, E., Gittelsohn, J., 2011. Access to food source and food source use are associated with healthy and unhealthy food-purchasing behaviours among low-income African-American adults in Baltimore City. *Public Health Nutrition* 14, 1632–1639.

Dinour, L.M., Bergen, D., Yeh, M.C., 2007. The food insecurity-obesity paradox: a review of the literature and the role food stamps may play. *Journal of the American Dietetic Association* 107 (11), 1952–1961.

Evanson, E., Manski, C., Scanlan, T., 1999. *Evaluating Food Assistance Programs in an Era of Welfare Reform: Summary of a Workshop*. The National Academies Press, Washington, DC.

Fan, M.Y., 2010. Do food stamps contribute to obesity in low-income women? Evidence from the National Longitudinal Survey of Youth 1979. *American Journal of Agricultural Economics* 92 (4), 1165–1180.

Flegal, K.M., Carroll, M.D., Ogden, C.L., Curtin, L.R., 2010. Prevalence and trends in obesity among US adults, 1999–2008. *Journal of the American Medical Association* 303 (3), 235–241.

Fox, M.K., Cole, N., 2004. Effects of food assistance and nutrition programs on health: Volume 1: Food stamp participants. E-FAN no. 04014-1, USDA Economic Research Service.

Fraker, T., Devaney, B., Cavin, E., 1986. An evaluation of the effect of cashing out food stamps on food expenditures. *American Economic Review* 76 (2), 230–234.

Frongillo, E.A., 2003. Understanding obesity and program participation in the context of poverty and food insecurity. *Journal of Nutrition* 133 (7), 2117–2118.

Gibson, D., 2003. Food Stamp Program participation is positively related to obesity in low income women. *Journal of Nutrition* 133 (7), 2225–2231.

Gibson, D., 2006. Long term Food Stamp Program participation is positively related to simultaneous overweight in young daughters and obesity in mothers. *Journal of Nutrition* 136 (4), 1081–1085.

Gibson-Davis, C.M., Foster, E.M., 2006. A cautionary tale: using propensity scores to estimate the effect of food stamps on food insecurity. *Social Service Review* 80 (1), 94–126.

Gordon, C., Purciel-Hill, M., Ghai, N.R., Kaufman, L., Graham, R., Van Wye, G., 2011. Measuring food deserts in New York City's low-income neighborhoods. *Health & Place* 17, 696–700.

Guthrie, J.F., Lin B.H., Ver Ploeg, M., Frazao, E., 2007. Can food stamps do more to improve food choices? *Economic Information Bulletin* 29-1, U.S. Department of Agriculture, Economic Research Service.

Han, E., Powell, L.M., Pugach, O., 2011. The heterogeneous relationship of food stamp participation with body mass: quantile regression model. *Food Policy* 36, 499–506.

Heller, R.F., Verma, A., Gemmell, I., Harrison, R., Hart, J., Edwards, R., 2007. Critical appraisal for public health: a new checklist. *Journal of the Royal Institute of Public Health* 122, 92–98.

Higgins, J.W., Lynne, W., Cunningham, S., Naylor, P.J., 2006. Out of the mainstream: low-income, lone mothers' life experiences and perspectives on heart health. *Health Promotion Practice* 7 (2), 221–233.

Jilcott, S.B., Haiyong, L., DuBose, K.D., Chen, S., Kranz, S., 2011. Food Stamp participation is associated with fewer meals away from home, yet higher body mass index and waist circumference in a nationally representative sample. *Journal of Nutrition Education and Behavior* 43 (2), 110–115.

Jones, S.J., Frongillo, E.A., 2006. The modifying effects of food stamp program participation on the relation between food insecurity and weight change in women. *Journal of Nutrition* 136 (4), 1091–1094.

Kaiser, L., 2008. Why do low-income women not use food stamps? Findings from the California Women's Health Survey. *Public Health Nutrition* 11 (12), 1288–1295.

Kaushal, N., 2007. Do food stamps cause obesity? Evidence from immigrant experience. *Journal of Health Economics* 26, 968–991.

King, G.A., Fitzhugh, E.C., Bassett, D.R., McLaughlin, J.E., Strath, S.J., Swartz, A.M., Thompson, D.L., 2000. Relationship of leisure-time physical activity and occupational activity to the prevalence of obesity. *International Journal of Obesity* 25, 606–612.

Landers, P., 2007. The Food Stamp Program: history, nutrition education, and impact. *Journal of the American Dietetic Association* 107, 1945–1951.

Leung, C.W., Villamor, E., 2011. Is participation in food and income assistance programmes associated with obesity in California adults? Results from a statewide survey. *Public Health Nutrition* 14 (4), 645–652.

Mari Gallagher Research & Consulting Group (November 12th 2007). 120 Chicago USDA Food Stamp retailers likely to be liquor stores. Available at: <[http://www.marigallagher.com/site\\_media/dynamic/project\\_files/ChicagoST\\_USDA\\_FdStmp\\_Liq.pdf](http://www.marigallagher.com/site_media/dynamic/project_files/ChicagoST_USDA_FdStmp_Liq.pdf)>.

- Meyerhoefer, C., Pylpchuk, Y., 2008. Does participation in the food stamp program increase the prevalence of obesity and health care spending? *American Journal of Agricultural Economics* 90 (2), 287–305.
- Meyerhoefer, C., Yang, M., 2011. The relationship between food assistance and health: a review of the literature and empirical strategies for identifying program effects. *Applied Economic Perspectives and Policy* 33 (3), 304–344.
- McLaren, L., 2007. Socioeconomic status and obesity. *Epidemiological Reviews* 29, 29–48.
- Morland, K.B., Evenson, K.R., 2009. Obesity prevalence and the local food environment. *Health & Place* 15, 491–495.
- Morland, K., Wing, S., Diez Roux, A., Poole, C., 2002. Neighborhood characteristics associated with the location of food stores and food service places. *American Journal of Preventative Medicine* 22 (1), 23–29.
- Moore, L.V., Diez Roux, A., Nettleton, J.A., Jacobs, D.R., 2008. Associations of the local food environment with diet quality – a comparison of assessments based on surveys and geographic information systems. *American Journal of Epidemiology* 167 (8), 917–924.
- Must, A., Spadano, J., Coakley, E.H., Field, A.E., Colditz, G., Dietz, W.H., 1999. The disease burden associated with overweight and obesity. *Journal of the American Medical Association* 282 (16), 1523–1529.
- Nord, M., Andrews, M., Carlson, S., 2007. Household food security in the United States, 2006. USDA Economic Research Service, Economic Research Service Report no. 49.
- Ogden, C.L., Yanovski, S.Z., Carroll, M.D., Flegal, K.M., 2007. The epidemiology of obesity. *Journal of Gastroenterology* 132 (6), 2087–2102.
- Ohls, J.C., Ponza, M., Moreno, L., Zambrowski, A., Cohen, R., 1999. Food Stamp Participants' Access to Food Retailers. Mathematica Policy Research, Princeton, NJ.
- Pawson, R., Greenhalgh, T., Harvey, G., Walshe, K., 2005. Realist review – a new method of systematic review designed for complex policy interventions. *Journal of Health Services Research and Policy* 10 (1), 21–34.
- Powell, L.M., Slater, S., Mirtcheva, D., Bao, Y., Chaloupkam, F.J., 2007. Food store availability and neighborhood characteristics in the United States. *Preventive Medicine* 44, 189–195.
- Ross, N.A., Tremblay, S., Khan, S., Crouse, D., Tremblay, M., Berthelot, J.M., 2007. Body mass index in urban Canada: neighborhood and metropolitan area effects. *American Journal of Public Health* 97 (3), 500–508.
- Schanzenbach, D.W., 2002. What are food stamps worth? Princeton University Industrial Relations Working Paper #468.
- Shapiro, J.M., 2005. Is there a daily discount rate? Evidence from the food stamp nutrition cycle. *Journal of Public Economics* 89 (2–3), 303–325.
- Shenkin, J.D., Jacobson, M.F., 2010. Using the Food Stamp Program and other methods to promote healthy diets for low-income consumers. *American Journal of Public Health* 100 (9), 1562–1564.
- Smiley, M.J., Diez Roux, A.V., Brines, S.J., Brown, D.G., Evenson, K.R., Rodriguez, D.A., 2010. A spatial analysis of health-related resources in three diverse metropolitan areas. *Health & Place* 16, 885–892.
- Townsend, M.S., Peerson, J., Love, B., Achterberg, C., Murphy, S.P., 2001. Food insecurity is positively related to overweight in women. *Journal of Nutrition* 131, 1738–1745.
- Tricco, A.C., Tetzlaff, J., Moher, D., 2009. The art and science of knowledge synthesis. *Journal of Clinical Epidemiology* 64 (1), 11–20.
- USDA (U.S. Department of Agriculture) 2011a (Jan. 18th 2011). Supplemental Nutrition Assistance Program eligibility requirements. Available at <[http://www.fns.usda.gov/snap/applicant\\_recipients/eligibility.htm](http://www.fns.usda.gov/snap/applicant_recipients/eligibility.htm)>.
- USDA (U.S. Department of Agriculture) 2011b (Jan. 18th 2011). Supplemental Nutrition Assistance Program participation and costs. Available at <<http://www.fns.usda.gov/pd/SNAPsummary.htm>>.
- USDA (U.S. Department of Agriculture) 2010a (Jan. 12th 2011). Supplemental Nutrition Assistance Program store eligibility requirements. Available at <<http://www.fns.usda.gov/snap/retailers/store-eligibility.htm>>.
- USDA (U.S. Department of Agriculture) 2010b (Jan. 13th 2011). Supplemental Nutrition Assistance Program eligible food items. Available at <<http://www.fns.usda.gov/snap/retailers/eligible.htm>>.
- USDA (U.S. Department of Agriculture) 2010c (Jan. 18th 2011). Characteristics of supplemental nutrition assistance program households: Fiscal Year 2009. Available at <<http://www.fns.usda.gov/ora/MENU/Published/snap/SNAPPartHH.htm>>.
- USDA (U.S. Department of Agriculture) 2010d (May 16th 2011). Reaching those in need: state supplemental nutrition assistance program participation rates in 2008. Available at <<http://www.fns.usda.gov/ora/menu/Published/snap/FILES/Participation/Reaching2008.pdf>>.
- USDA (U.S. Department of Agriculture) 2010e. Food and Nutrition Service, Office of Research and Analysis. Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2009, Alexandria, VA.
- Ver Ploeg, M., Mancino, L., Lin, B., Wang, C., 2007. The vanishing weight gap: trends in obesity among adult food stamp participants (US) (1976–2002). *Economics & Human Biology* 5 (1), 20–36.
- Ver Ploeg, M., Ralston, K., 2008. Food stamps and obesity: what do we know? USDA Economic Research Service. Economic Information Bulletin, 34.
- Wang, Y., Beydoun, M.A., 2007. The obesity epidemic in the United States – Gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiologic Reviews* 29, 6–28.
- Walker, R.E., Keane, C.R., Burke, J.G., 2010. Disparities and access to healthy food in the United States: a review of food deserts literature. *Health & Place* 16, 876–884.
- Webb, A.L., Schiff, A., Currivan, D., Villamor, E., 2008. Food Stamp Program participation but not food insecurity is associated with higher adult BMI in Massachusetts residents living in low-income neighbourhoods. *Public Health Nutrition* 11 (12), 1248–1255.
- Wiig, K., Smith, C., 2009. The art of grocery shopping on a food stamp budget: factors influencing the food choices of low-income women as they try to make ends meet. *Public Health Nutrition* 12 (10), 1726–1734.
- Wilde, P.E., 2007. Measuring the effect of food stamps on food insecurity and hunger: Research and policy considerations. *Journal of Nutrition* 137, 307–310.
- Wilde, P.E., McNamara, P.E., Ranney, C.K., 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 (4), 959–971.
- Wilde, P.E., Ranney, C.K., 2000. The monthly food stamp cycle: shopping frequency and food intake decisions in an endogenous switching regression framework. *American Journal of Agricultural Economics* 82 (1), 200–213.
- Yanovski, S.Z., 2003. Binge eating disorder and obesity in 2003: could treating an eating disorder have a positive effect on the obesity epidemic? *International Journal of Eating Disorders* 34, S117–S120.
- Zagorsky, J.L., Smith, P.K., 2009. Does the US Food Stamp Program contribute to adult weight gain? *Economics & Human Biology* 7 (2), 246–258.
- Zenk, S.N., Schulz, A.J., Israel, B.A., James, S.A., Bao, S., Wilson, M.L., 2005. Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in Metropolitan Detroit. *American Journal of Public Health* 95 (4), 660–667.
- Zhang, Q., Chen, Z., Diawara, N., Wang, Y., 2011. Prices of unhealthy foods, food stamp program participation, and body weight status among U.S. low-income women. *Journal of Family and Economic* 32 (2), 245–256.
- Zhang, Q., Wang, Y.F., 2004. Trends in the association between obesity and socioeconomic status in US adults: 1971 to 2000. *Obesity Research* 12 (10), 1601–1622.