

Supplemental Nutrition Assistance Program (SNAP): does receiving assistance impact food choices?

This article was published in the following Dove Press journal:
Nutrition and Dietary Supplements

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Abstract: The Supplemental Nutrition Assistance Program (SNAP) is the largest federal program that provides assistance for the purchase of foods to low-income households in the United States. SNAP plays a valuable role in alleviating hunger and food insecurity in poor households; however, one consideration that remains relatively unexplored is the influence of this program on food choices. Food choices are guided by several factors in low-income individuals, including the cost of food, household size, nutrition knowledge, availability of fresh foods in the neighborhood, transportation, and cultural factors. Also, the complex relationship between SNAP participation and food choices is further confounded by the factors of demographics, food insecurity, poverty, and self-selection. There is a lack of quantitative investigations that directly evaluate food choices in SNAP recipients. As a result, this review will focus on summarizing findings from studies that assessed food purchasing patterns, diet quality, and weight gain in SNAP participants. These outcomes may serve as proxy measures to evaluate the food choices made by SNAP participants. In addition, this review discusses many behavioral economic strategies such as reducing the cost of healthy foods, providing monetary benefits for purchase of healthy foods, increasing the SNAP benefits, incentivizing small food retailers to offer more food choices in low-income neighborhoods, increasing grocery stores and supermarkets in poor neighborhoods, and strengthening the SNAP-Education program; some of which have been previously adopted to promote the selection of healthy foods in SNAP participants. SNAP has the potential to impact food choices in the society, as such longitudinal studies are needed to evaluate the effectiveness of any reforms in SNAP benefits or restrictions, which may seem logical but not impact food choices in reality.

Keywords: Supplemental Nutrition Assistance Program, food choices, grocery purchase, diet, diet quality, obesity

Introduction

The Supplemental Nutrition Assistance Program (SNAP) is the largest federal program that provides assistance for the purchase of foods to low-income households in the United States (U.S.).¹ It provides food purchasing benefits to households with an annual income level of $\leq 130\%$ of the Federal Poverty Level (FPL) and household assets of $< \$2000$.² The original name was the Food Stamps program which was established in 1964. The renaming occurred in 2008 in order to increase its focus to improve nutrition in beneficiaries.² In the fiscal year 2018, SNAP benefits totaled \$60.6 billion, which were provided to 40.3 million Americans.

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The average benefit per person per month was \$125.63, with two-thirds of all SNAP participants being children, elderly or those with a disability; the majority live below the FPL.³ This program is based on United States Department of Agriculture's (USDA) Thrifty Food Plan (TFP), a low-cost plan which suggests monthly food expenses derived from the consumer price index.⁴ The funds are distributed monthly on an electronic benefits transfer card, which can be used to purchase most foods and beverages, except dietary supplements, alcohol, tobacco, and ready to eat foods.⁵

The SNAP plays a major role in reducing hunger and food insecurity in low-income Americans.⁶ It is designed such that the maximum benefits (92%) are received by households with incomes at or below the poverty line, while 56% go to households at or below half of the poverty line (about \$10,390 for a family of three in 2018).⁶ This program acts as a safety net for the elderly, those with disability, temporarily unemployed, and low-income wage workers.⁶ In addition, it provides adequate nutrition support to low-income groups by strengthening their power to purchase foods. Finally, SNAP nutrition education programs help to improve the food choices made by the recipients.⁶

However, food choices are guided by numerous factors in low-income individuals, including the cost of food,⁷ household size,⁸ nutrition knowledge,⁹ transportation,¹⁰ and cultural factors.^{11,12} A focus group study analyzed the food choices among food stamp participants.⁸ The conclusion was that the cost of the food was the major consideration in deciding which items were purchased. Family size was an additional influence, with those having larger families preferring inexpensive foods in bulk in order to satisfy the needs of everyone.⁸ Lack of nutrition knowledge, problems in understanding food labels and less support from the family for healthy recipes were few other barriers reported for eating healthy.⁸ Lack of personal transportation restricts grocery expenditures to the nearest convenience store.¹³ Yet, an analysis of the National Household Food Acquisition and Purchase Survey dataset study found that a constraint in transportation did not result in difference in types of stores, as compared to their non-participating counterparts.¹⁴ Culture is yet another significant factor in determining food choices. This is especially true in Hispanic and African-American households, as most preferred preparing traditional recipes.⁸ Very few individuals declared that their food choices were influenced by the media, nutrition knowledge, and/or physician advice.⁸

SNAP provides food assistance to the vulnerable and low-income populations. However, there is limited evidence from quantitative studies that directly assess the effect of participation in SNAP on food choices. Therefore, the goal of this review is to analyze the existing literature on outcomes of food expenditure patterns, diet quality, and obesity in SNAP participants, with the purpose of studying food choices from these proxy measures.

Potential impact of SNAP on food choices

About one in eight Americans participate in SNAP each month.¹⁵ It serves as a valuable program to reduce food insecurity in numerous high-risk segments of the population. However, recent adequacy of SNAP benefits has been debated. Reasons include geographical variations in the cost of foods,¹⁶ problems associated with the TFP which forms the basis of the SNAP⁴ and frequency of distribution of the monthly benefits.

Geographical variations in the cost of food

SNAP benefits are fixed across the 48 states (higher in Alaska and Hawaii); however, variations in pricing of the food items occur in different areas of the country. At present, SNAP benefits are not adjusted to regional differences in food prices, as it would be politically untenable.

Thrifty food plan

A problem with the TFP being the basis for the SNAP benefits is that it is focused primarily on food items that are raw or require significant time for preparation.⁴ The underlying assumption is that individuals have sufficient time and skills for preparation, accessibility, and affordability to all food items. Furthermore, the TFP offers only a limited variety of foods, hampering its ability to meet the Dietary Guidelines.⁴

Frequency of distribution

SNAP benefits are distributed at the beginning of every month. However, the majority of grocery shopping takes place within the first 3 days of receipt of benefits.^{17,18} This distribution leads to a pattern known as "food stamp cycle" in which participants use their SNAP benefits within the first 2 weeks of receipt.¹⁹ Research shows that this infrequent distribution of benefits may have a negative influence on participants' nutritional status. It has been shown that some food stamp recipients have cyclical patterns of food consumption, characterized by periods of overconsumption during the first part of the month after receiving benefits when financial resources and food are

more abundant.^{20,21} This is followed by a period of under-consumption at the end of the benefit cycle when the quantity and quality of foods being consumed are reduced due to the depletion of benefits.^{20,21}

All the above factors may influence the choices for foods selected by SNAP participants. In the absence of studies that directly assess food choices, this review aims to collect, analyze, and summarize the evidence on food choices using outcomes of patterns of food expenditures, nutrient intake and diet quality, and weight gain in the SNAP participants.

Design

Figure 1 illustrates the process of literature review and study selection. A search of the databases of PubMed, Web of Science, Embase, and Cochrane Library was conducted to identify prospective, case-controlled, and cross-sectional studies investigating food purchasing patterns, food expenditures, food choices, nutrition, and diet quality assessment in SNAP participants from January 1963 to December 2018. Keywords chosen were Supplemental Nutrition Assistance Program or SNAP, low-income households, adequacy of the SNAP, variations in SNAP

benefits, food purchasing patterns, food expenditure, diet quality, diet analysis, and nutrient analysis.

Inclusion and exclusion criteria

Inclusion criteria were prospective, cross-sectional, or case-control investigations that measured food expenditures and diet or diet quality of SNAP and income-eligible non-SNAP individuals. Exclusion criteria were the absence of full text and not being available in English.

Data extraction

A total of 124 studies were retrieved using the keywords listed above. Two investigators separately examined the studies and the results were compared. Duplicate experiments were removed, and any disagreement regarding inclusion was resolved with the help of a third researcher. Initially, 65 studies were retrieved, which were then subject to the exclusion criteria, this resulted in a total of 51 studies included in the final analysis. The main findings of the studies were divided into three topics for assessing evidence for food choices in SNAP participants: investigations on food expenditure; nutrient intake and diet quality; and obesity and body mass index (BMI).

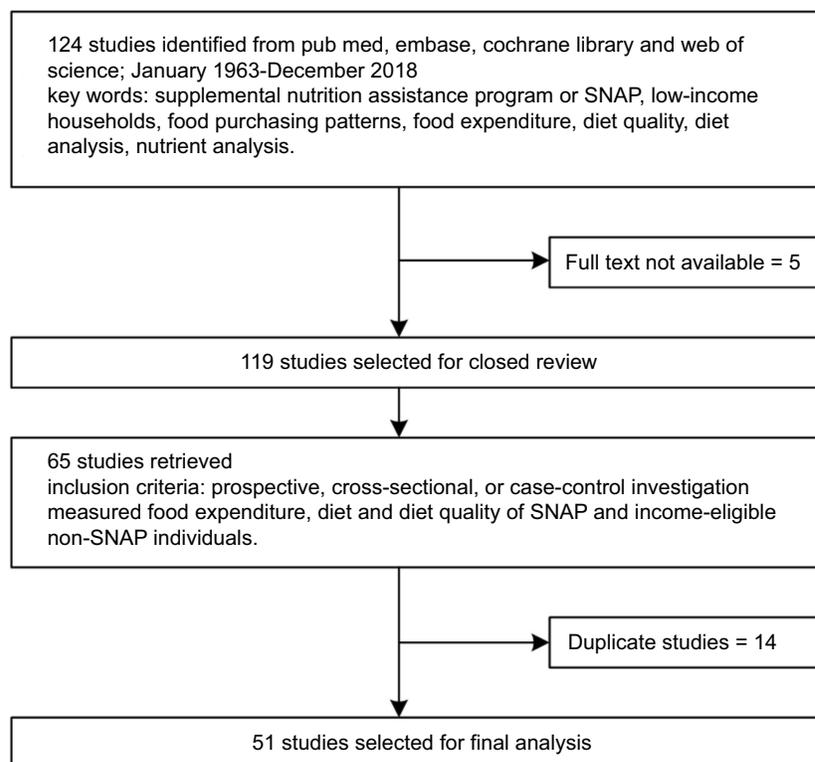


Figure 1 Flowchart demonstrating the process of study selection for systematic review on the food purchasing patterns and diet quality of Supplemental Nutrition Assistance Program (SNAP) and non-SNAP participants.

Quality of evidence

This systematic review used the GRADE (Grading of Recommendations Assessment, Development, and Evaluation Working Group) to evaluate the quality of evidence for the three different outcomes considered: food expenditures, diet quality, and BMI/obesity in SNAP participants.²² The GRADE uses a criterion based on an assessment of four factors for each outcome: risk of bias, consistency, directness, and precision.²² Table 3 illustrates the process of grading the evidence for the three outcomes based on these four criteria. In this review, randomized-controlled trials were rated as high evidence and observational studies as low. The grade for the outcome was reduced if there were any inconsistencies in the results of the studies or the methods for assessment of the outcomes, uncertainty about directness, small data sizes, reporting bias or serious limitations in the studies.²³ The grade was increased if there was a strong or very strong evidence of association ($p < 0.05$) based on evidence from observational studies, with adjustment for confounders, with the satisfaction of internal validity.²³ Based on the above criteria, the quality of evidence was rated as high, moderate, low, and very low.²²

Results

Food choices influenced by the inadequacies of the SNAP

Leibtag et al, showed that food prices in the West and Northeast are above average, while those in the South and Midwest are below the mean.¹⁶ This uneven distribution of food costs suggests that clients in the South and Midwest can purchase more healthy food items, as compared to those in the West and Northeast.¹⁶ Bronchetti et al, utilized the 1999–2010 data from the National Health Interview Survey and found that in areas with lower food prices, higher real SNAP purchasing power was linked to a lower probability of being food insecure in children, ages 17 and under.²⁴

The TFP is used to calculate the benefits for the SNAP clients. Research at the Tulane University concluded that the recipients would need to spend 2 hrs daily for preparing meals in order to follow the TFP.⁴ In single adult households with children, some are constrained by time for food preparation. These households spend 142% of the TFP cost on food, as compared to two adult households that spend 119% of the TFP cost. Thus, SNAP benefits may be insufficient to meet the needs of single-parent families.⁴

Few studies have investigated the variations in the utilization of the benefits over the period of a month. Hastings et al, reported that food expenditures, relative to non-benefit recipients, fall by 30% in week 4 after benefit distribution as compared to week 1.²⁵ This uneven dissemination of funds leads to a decline of benefits as the month progresses, resulting in a deterioration of nutrient intake and diet quality over time.²⁶ Hamrick et al, found that the likelihood of not eating in a day increased toward the end of the month, when the benefits are exhausted.²⁷ Sanjeevi et al, observed a significant decrease in the consumption of fruits, vegetables, and diet quality of SNAP women participants toward the end of the monthly benefit period.²⁶ In 244 African-American SNAP participants, a decrease in the diet quality occurred over time since SNAP distribution.²⁸ Thus, these studies provide evidence of a decline in diet quality from the time of receipt of benefits.

Food choices as illustrated by food expenditure studies

The food purchasing patterns of SNAP households are described in Table 1. Previous studies have utilized grocery receipts and other food acquisition data to investigate the food purchasing patterns of SNAP households. In a cross-sectional study of 4826 households, Tiehen et al, documented lower expenditure of food in SNAP households, as compared to non-SNAP households, after adjusting for the household size and composition. Also, SNAP households exhibited the highest expenditure on food items just after receipt of the benefits.²⁹

In a recent focus group study by Moran et al, SNAP participants reported that they purchased ultra-processed foods because these items have a long shelf life and could be stored to prevent food shortage at the end of the month.³⁰ Franckle et al, analyzed the sales data over a period of two years and found that the SNAP participants spent greater on sugary beverages, red meat, and convenience foods and less on vegetables, fruits, and poultry as compared to nonparticipants.³¹ In 2017, Gustafson et al, reported that SNAP households purchased more (62%) sugar-sweetened beverages (SSBs) (41%) and less milk (60%) compared to non-SNAP participants.³² Similar results were shown by two other studies by Grummon et al, and Andreyeva et al, who documented that SNAP benefits were used to purchase foods higher in saturated fats and sodium³³ and SSB, respectively.³⁴

In contrast, a 2011 study by the USDA collected point of sale data from grocery stores, supermarkets, and drug

Table 1 Characteristics of studies included in the systematic review of food purchasing patterns in the Supplemental Nutrition Assistance Program (SNAP) and non-SNAP participants

Study, Reference	Participants	Methods	Findings
Moran et al, 2019 ³⁰	45 SNAP and non-SNAP households	Focus group	Some SNAP clients purchased ultra-processed foods because of longer shelf life; storage would prevent problem of food shortage at the end of the month
Sanjeevi et al, 2018 ³⁶	160 SNAP women participants	Cross-sectional analysis of grocery receipts	Highest expenditures were made on refined grains, red meat, whole fruits, and other vegetables. Lowest expenditures were soups, orange vegetables, whole grain breads, rice, and pasta.
Tiehen et al, 2017 ²⁹	4826 SNAP and non-SNAP households	Cross-sectional analysis of food acquisition and purchase survey data	Spending on food was lower in SNAP households than income-eligible non-SNAP, after adjusting for household size and composition. Daily food expenditures were higher on days just after benefits were received.
Gustafson et al, 2017 ³²	1581 SNAP and 1382 non-SNAP households	Cross-sectional analysis of Food Acquisition and Purchase Survey data	SNAP households purchased more sugar-sweetened beverages than non-SNAP households (62% vs 41%) and less milk (54% vs 60%)
Franckle et al, 2017 ³¹	188 stores across five states (Maine, Massachusetts, Vermont, New Hampshire, New York)	Sales data from a chain supermarket in Northeastern US over 2 years	SNAP clients spent less on fruits, vegetables, and poultry and more on sugar-sweetened beverages (SSB's), red meat, and convenience foods than nonparticipants
Grummon et al, 2017 ³³	98,256 SNAP and non-SNAP households	Cross-sectional analysis of 2012–2013 packaged food and beverage purchases by SNAP participants.	SNAP households spent less on fruits, vegetables and fiber, but more on sugar-sweetened beverages, salty snacks, sweeteners, and processed meat than nonparticipants
Garasky et al, 2016 ³⁵	26.5 million SNAP and non-SNAP households	Cross-sectional analysis of point of sale transaction data	No major differences in expenditures between SNAP and non-SNAP households. Proteins were major food product purchased
Anderson et al, 2016 ³⁷	SNAP clients	Cross-sectional study Analysis of 2001–2014 Food Security Supplements of the current population surveys	An increase in SNAP benefits by \$1 would raise food spending by 68¢ per capita; \$30 would increase expenditure by \$19.48
Andreyeva et al, 2012 ³⁴	39,172 SNAP households	Cross-sectional analysis of grocery store scanner data from a regional supermarket chain	72% of sugar-sweetened beverages were purchased using SNAP benefits. Expenditure on SSB's was higher than those on all groceries (63%), diet (65%), and unsweetened beverages (59%)
Bradbard et al, 1997 ⁸	28 focus groups of SNAP participants	Focus group	Food purchased at beginning of month are those that can be stored for later consumption (canned vegetables and grains)

stores. For every \$1, both SNAP and non-SNAP households spent 40 cents on basic items of vegetables, milk, eggs, bread; 20 cents on sweetened beverages, desserts, and salty snacks; and 40 cents on cereals, rice, and beans.³⁵ The conclusion was that SNAP and non-SNAP households spent a similar amount of money on sweetened beverages, salty snacks, and prepared beverages.³⁵ In another study by Sanjeevi et al, higher expenditures were reported for red meat, refined grains, whole fruits, and other vegetables in

SNAP households.³⁶ In addition, the household percentage expenditures for dark green and orange vegetables, and whole grains were significantly lower than the TFP recommendations.³⁶

Most of the research to date has conducted secondary analysis of national datasets to predict variations in food choices as SNAP benefits change. Anderson et al, predicted an increase in expenditure on groceries by \$19.48, with a raise of \$30 per capita in monthly SNAP benefits.³⁷

It was further found that this increase in spending was related to higher consumption of healthier foods and lower food insecurity in the participants.³⁷

Economic Research Service estimated the demand elasticities using the 1987–88 Nationwide Food Consumption Survey; it was concluded that a decline of 20% in food price would raise fruit and vegetable consumption by 2.2 cups in SNAP recipients.³⁸ Yet, the Consumer Expenditure Survey (CE) of the Bureau of Labor Statistics data of 1991 and 2000 predicted no increase in purchase of fruits and vegetables as SNAP benefits escalated by \$1.³⁹

Finally, Castner et al, used data from the 1996 National Food Stamp Program Survey (NFSPS) and 2001–2004 surveys to investigate associations between spending on food and diet quality using the HEI-2005.⁴⁰ A 10% increase in spending on food was positively associated with a rise in a household's HEI-2005 score of 0.33% via NFSPS data, and an increase of 0.30% via NHANES data.⁴⁰ With both datasets, improvements in diet quality were higher with an increase in benefits for fruit and vegetables.

Food choices as illustrated by nutrient intake and diet quality studies

The SNAP has played a major role in reducing hunger and food insecurity in the US. [Table 2](#) illustrates the effect of participation in SNAP on the diet quality of individuals. Diet quality refers to both the quality and variety of the diet as measured by assessing the extent of alignment of food patterns with dietary guidelines.⁴¹ The results from studies investigating diet quality in SNAP recipients have been inconsistent, with some investigations observing none to negative^{42–44} impact on diet quality. For example, Lacko et al, documented comparable consumption of calories from fast-foods, and lower consumption of whole fruits and whole grain in both participants and nonparticipants.⁴⁵ Yet, Zhang et al, analyzed NHANES data of 38,696 adults from 1999 to 2014 and found lower diet quality scores of SNAP participants as compared to the nonparticipants over the years.⁴³ Furthermore, results from a secondary analysis of NHANES data from 1999–2012⁴⁶ and 2007–2010⁴⁴ showed that SNAP participants had lower diet quality as compared to income-eligible nonparticipants. Taille et al, documented that SNAP households consumed greater energy from SSBs, desserts, processed meats as compared to their counterparts.⁴⁷ A systematic review documented

that adult SNAP participants had poor diet quality as compared to the nonparticipants. However, intake of total kilocalories, macro and micronutrients did not differ significantly between participants and income-eligible nonparticipants.⁴⁸ Finally, Nguyen et al, found that SNAP participation improved diet quality in the food insecure groups.⁴⁹

In the analyses of a national dataset, participation in SNAP was associated with an increased probability of consumption of whole fruits by 23%.⁵⁰ This increase may be because of the extra income through SNAP and the convenience factor associated with eating fruits that require no preparation time.⁵⁰ Similar consumption of fruits and vegetable has been documented in both participants and nonparticipants.^{42,51,52} In contrast, consumption of dark green/orange vegetables was found to be low in SNAP participants.⁵⁰

The evidence on the consumption of SSBs in SNAP vs the nonparticipants is mixed; with few reporting higher consumption^{42,53,54} to no differences.^{55,56} However, two of the investigations showing higher consumption in SNAP participants analyzed regional data sets^{34,57} and one did not report any difference for men.⁴² The evidence of SNAP on other food choices such as whole grains is also mixed. A study by Caster et al, found that SNAP recipients used more whole grains and grains that were more nutrient dense, as compared to income-eligible participants.⁴⁰ In contrast, in a secondary analysis of the NHANES data involving 3142 women, Jun et al, reported no differences in whole grain intake between low-income and high-income women groups. The Hilmers et al, study on low-income women, consumption of whole grains was found to be lower both in participants and non-SNAP participants relative to the dietary guidelines.⁵⁸ Few other studies have documented similar consumption of total grains among both groups.^{51,56}

Food choices from weight and BMI studies

Previous research has documented higher weight gain and obesity in adult women SNAP participants^{20,59–61} and female children,^{62,63} but a decrease in obesity for male children.⁶² Analysis of the data from 2003 to 2006 NHANES showed that the SNAP participation was directly related to obesity [prevalence ratio: 1.58] in both adult men and women participants.⁶⁴ In Los Angeles, SNAP participants were found to have twice the higher odds of obesity, as compared to nonparticipants.⁶⁵ In contrast, analysis of the NHANES data from an earlier period,

Table 2 Characteristics of the studies included in the systematic review on diet quality in the Supplemental Nutrition Assistance Program (SNAP) and non-SNAP participants

Study, Reference	Participants	Methods	Findings
Lacko et al, 2018 ⁴⁵	2523 SNAP participants and nonparticipants	Cross-sectional study analysis of NHANES 2011–2014	SNAP clients consumed greater amounts of solid fats and added sugar from at home foods than non-SNAP participants. Both groups consumed low quantities of non-starchy vegetables, whole fruits, and whole grains
Zhang et al, 2018 ⁴³	38,696 SNAP participants and nonparticipants	Cross-sectional study analysis of NHANES 1999–2014	From 2003 to 2014, there was less improvement in diet quality scores of SNAP participants (change in average score=0.57) as compared to both income-eligible nonparticipants (2.56) and higher-income individuals (3.84)
Taillie et al, 2018 ⁴⁷	76,458 SNAP and non-SNAP households	Cross-sectional study nutrition profile of purchases by store type 2010–2014	Calories obtained from processed meat, starchy vegetables, sweeteners, desserts, toppings, total junk food, sugar-sweetened beverages, and milk were higher among SNAP participants as than income-eligible and higher-income nonparticipants
Gu et al, 2017 ⁴⁶	38,487 Children and adolescents	Cross-sectional study analysis of NHANES 1999–2012	After the 2003–2004 cycle, SNAP clients scored lower on the Healthy Eating Index-2010 than nonclients
Condon et al, 2015 ⁴⁴	SNAP participants and nonparticipants	Cross-sectional study analysis of NHANES 2007–2010	SNAP clients consumed more energy from solid fats and added sugars; and scored lower on the HEI-2005 than both income-eligible and higher-income nonparticipants
Andreyeva et al, 2015 ⁴⁸	25 studies SNAP participants and nonparticipants	Systemic review	Adult SNAP participants had lower scores on the Healthy Eating Index than SNAP-eligible nonparticipants and SNAP-ineligible nonparticipants. Diets for children were similar for both groups
Nguyen et al, 2015 ⁴⁹	SNAP participants and nonparticipants	Analysis of NHANES 2003–2010	Participation in SNAP was associated with better diet quality in marginal, low, and very low food security groups
Nguyen et al, 2015 ⁵⁴	SNAP participants and nonparticipants	Analysis of NHANES 2003–2010	Total kilocalorie intake from sugar-sweetened beverages was higher (12%) than income-eligible nonparticipants (9%) and those who were ineligible to participate (6%)
Bleich et al, 2013 ⁵⁵	SNAP participants and nonparticipants	Examination of patterns of adult consumption of SSBs by SNAP eligibility 2003–2010	Percentage consumption of sugar-sweetened beverages and per capita calorie intake from SSBs were higher in individuals receiving SNAP than those not eligible to participate in SNAP
Leung et al, 2013 ⁵²	Children with household incomes of <130% of Federal Poverty Level	Cross-sectional analysis of NHANES ^a 1999–2008	Diets of SNAP clients had 44% more servings of processed meats, 43% more servings of sugar-sweetened beverages and 47% more servings of high-fat dairy than nonclients. No significant differences were observed for whole grains, fruits, and vegetables between group

Note: ^aNational Health and Nutrition Examination Survey.

1999–2002, did not find any differences in BMI between SNAP participants and nonparticipants.⁶⁶ Zagarosky et al found that BMI of women SNAP participants was greater than one unit higher as compared to nonparticipants with similar socio-economic characteristics.⁶⁷ Furthermore, the length of participation in SNAP showed a cumulative effect on BMI; longer periods were related to greater increases in BMI.⁶⁷ In contrast, Fan et al, analyzed the National Longitudinal Study of Youth data, and found no

association between participation in SNAP and obesity in adult women.⁶⁸ Three longitudinal studies found that participation in SNAP over a long period of time was associated with a higher BMI in young girls, young daughters of mothers who were obese, and children living in cities.^{63,69,70}

The results from studies in men are mixed. Results from studies, six^{59,61,67,70–72} found no association between participation in SNAP and risk of obesity, however, two

Table 3 GRADE (Grading of Recommendations Assessment, Development, and Evaluation Working Group) to evaluate the quality of evidence for the different outcomes used to assess food choices

Outcome measured, studies (n)	Design, studies (n)	Risk of bias	Consistency	Directness	Precision	Quality of evidence
Food expenditure (10)	Focus group (2)	Participants may not choose to express their thoughts from fear of judgment, self-selection of participants in the focus groups, included only Supplemental Nutrition Assistance Program (SNAP) participants, discussion mainly steered by the moderator	Consistent differences observed in food expenditure patterns between SNAP and nonparticipants	Low; information provided by participants	Very low precision	Very low
	Cross-sectional (7)	Self-selection in SNAP; participants may differ in certain characteristics, no evidence of a temporal relationship between exposure and outcome, self-completed questionnaires	Consistent findings	Moderate; use of point of sale data, grocery receipts	Low to moderate; sample sizes were >1000, odds ratio for studies varied between 0.84 and 2.50, narrow confidence intervals, most of the studies adjusted for household and neighborhood characteristics	Moderate
Diet quality in adults (15)	Cross-sectional, used convenience samples (4) nationally representative data (11)	Self-selection in SNAP; participants may differ in certain characteristics, recall bias, convenience sample may or may not be representative of population studies, no evidence of a temporal relationship between exposure and outcome, self-reported data	Mixed results on diet quality across studies	Low to moderate; different tools used to capture dietary intake and diet quality	Low to moderate precision, most studies used large national samples (n> 1000), recorded significant differences (p<0.0001), adjusted for confounding related to sociodemographic factors. Three studies used rigorous statistical techniques to study causality	Low-moderate
Diet quality in children (6)	Cross-sectional, used nationally representative data (6)	Self-selection, self-reported data, recall bias, no evidence of a temporal relationship between exposure and outcome	Consistent results on diet quality	Low to moderate; different tools used to capture dietary intake and diet quality	Moderate precision, most studies used large national samples (n> 1000), small standard errors associated with estimates. Most of the studies adjusted for confounding related to sociodemographic factors	Moderate
Diet quality in households (6)	Cross-sectional, used convenience (1) nationally representative data (5)	Self-selection, self-reported data, recall bias, convenience sample may or may not be representative of population studies, no evidence of a temporal relationship between exposure and outcome. Studies did not account for dietary differences at individual level.	Mixed results	Low to moderate	Low precision, most large national samples (n>1000) recorded no to some differences (p<0.0001), however, household data does not account for individual differences in diet.	Low

(Continued)

Table 3 (Continued).

Outcome measured, studies (n)	Design, studies (n)	Risk of bias	Consistency	Directness	Precision	Quality of evidence
Obesity in males (8)	Cross-sectional (4)	Self-selection in SNAP, no evidence of a temporal relationship between exposure and outcome, studies did not account for the duration of participation in program and benefits received	Mixed results	Low to moderate; BMI and waist circumference used to measure weight	Low precision, no adjustment for confounding effect of time, sample sizes were moderate to large, estimates varied between studies, with significant to insignificant <i>p</i> -values	Low
	Longitudinal (4)	Self-selection in SNAP, loss of participants was moderate to substantial, could affect the validity of results, longitudinal design allowed to observe effect of time on weight gain	Mixed results	Moderate; BMI used to measure weight	Low to moderate precision, adjusted for time.	Low-moderate
Obesity females (11)	Cross-sectional (5)	Self-selection in SNAP, no evidence of a temporal relationship between exposure and outcome, studies did not account for the duration of participation in program and benefits received	Consistent findings	Moderate; BMI used to measure obesity	Low to moderate precision, no adjustment for confounding effect of time, estimates were low to moderate	Low-moderate
	Longitudinal (3)	Loss of participants was not substantial, longitudinal design allowed to observe effect of time on weight gain	Consistent findings	Moderate, BMI used to measure obesity	Low to moderate precision, adjusted for time, estimates were precise with narrow confidence intervals	Moderate
Obesity in children (8)	Cross-sectional (5)	Self-selection in SNAP, no evidence of a temporal relationship between exposure and outcome, studies did not account for the duration of participation in program and benefits received	Consistent findings	Moderate, BMI used to measure obesity	Low to moderate precision, no adjustment for confounding effect of time, estimates were precise with narrow confidence intervals and standard errors.	Low-moderate
	Longitudinal (6)	Self-selection in SNAP, loss of participants was not substantial, longitudinal design allowed to observe effect of time on weight gain	Consistent findings	Moderate, BMI used to measure obesity	Low to moderate precision, adjusted for time, type of assistance received, maternal and household characteristics, small standard errors	Moderate

Abbreviation: BMI, body mass index.

other studies showed that participation was linked to higher BMI in men.^{60,73} In a study of 435 low-income individuals, receipt of SNAP benefits was related to a higher BMI.⁶⁰ Also, Baum et al, documented that long-term participation in SNAP was associated with a 15% increase in the risk of obesity. However, this effect was not significant over a short and moderate period of 9 and 9–23 months, respectively.⁷³

The effect of increased consumption of healthy foods on weight gain has been documented. In a simulation study by Han et al, a 20% reduction in the price of fruits and vegetables produced a greater reduction in BMI in SNAP participants vs nonparticipants.⁷⁴ Similarly, a stochastic microsimulation analysis study observed a decrease in the incidence of obesity by 0.2% when fruits and vegetables were subsidized in SNAP clients.⁷⁵ Thus, a reduction in prices of healthy foods might increase their consumption and lead to a reduction in the risk of obesity.

Discussion

SNAP is invaluable in terms of alleviating hunger and food insecurity in low-income households. Yet, it is difficult to evaluate whether SNAP influences the types of foods purchased as food choices are affected by numerous factors in the low-income, which include the cost of food, household size, nutrition knowledge, availability of fresh foods in the neighborhood, transportation, and cultural factors.⁸ Factors affecting food choices in low-income groups were evaluated using the focus group study held in six cities across the United States. The study included 28 focus groups of SNAP recipients from various ethnic groups (white non-Hispanics, African Americans, Hispanics), both working and non-working groups, as well as individuals from rural and urban areas. This focus group study included a diverse sample from all different groups and regions. However, a major limitation of focus group investigations is that participants may be hesitant to express their personal and honest opinions, from the fear of judgment or opposition from others.

SNAP has the potential to impact food choices due to issues with the design of the program. The benefit amount does not change in different geographic regions of the country, despite the varying cost of foods. Thus, the purchase of high cost, nutrient-rich foods such as fruits and vegetables may be compromised in areas where the cost of foods are higher.¹⁶ Although some adjustments exist in whether the way the net income is calculated in areas with a higher cost of living, evidence is limited as to

whether these adjustments are sufficient to compensate for the greater expenditures on foods.²⁴ Also, the benefits that are set based on the TFP may be too low for participants to purchase a healthy diet.⁴ This is particularly true because of the implicit assumption in the plan that SNAP clients prepare a large proportion of their foods from raw food materials.⁴

Another problem is that the distribution of benefits once a month may result in a “feast and famine cycle” among some SNAP participants.⁷⁶ By the end of the month, the nutritional quality of the diet may have declined.²⁶ Demonstration projects are needed to evaluate the impact of a bi-monthly distribution pattern on food expenditure and consumption in different demographic settings among SNAP participants.

Previous studies have analyzed grocery receipts or point of sale data for capturing food expenditure patterns in SNAP participants. Most of the studies reported differences between types of foods purchased and total spending in SNAP vs non-SNAP households. However, SNAP households may be different from households that do not participate in ways that affect their purchases. SNAP households have been found to be more disadvantaged, with a lower monthly income as compared to SNAP eligible nonparticipants households.²⁹ In addition, family heads in the SNAP families were less educated and less likely to be employed as compared to heads in non-SNAP households.²⁹ SNAP households were found to contain more children than eligible nonparticipant households.²⁹ It is possible that the availability of free lunches and breakfasts at school, enables SNAP households with children to spend relatively less on food.²⁹ Finally, all the food expenditure studies were cross-sectional in nature; as a result, no causal association between SNAP participation and food expenditures or choices can be inferred.

Whether diet quality differs between SNAP and income-eligible non-SNAP participants remain unclear. While most of these studies analyzed national datasets, a few have utilized local convenience samples.^{51,58} In addition, differences existed in populations studied ranging from children,^{52,77} adults,^{42,55,56} to the elderly.^{51,56} The variability in study designs, methodology, and sample makes it difficult to compare. The results from national samples document similar or low dietary quality in adult SNAP participants as compared to non-recipients; however, the diets of children on SNAP were similar to low-income nonparticipants. This disparity could be explained by the participation of low-income children in additional programs such as the National School

Lunch Program and the School Breakfast Program.⁷⁸ It should be noted that most of the dietary studies were cross-sectional in design, limiting the ability to establish a causal link between SNAP participation and poor diet quality or nutrient intake.

Self-selection is another factor that limits the ability to infer causality between SNAP participation and diet quality. Only 60% of the income-eligible recipients participate in food assistance programs and many report no need for nutrition assistance.⁷⁹ Previous research has reported that SNAP nonparticipants may have attained higher education,⁸⁰ live in higher-income neighborhoods,⁸¹ and have other sources of financial support. Leung et al, indicated that individuals who participate in SNAP may have greater poverty and food insecurity and receive inadequate nutrition than those who do not.⁸²

The results of obesity studies are inconclusive. But why is there evidence that SNAP is associated with obesity? One suggestion has been that the absence of restrictions on the purchase of SSBs, or foods that are higher in sugar and fat, may increase consumption of these foods.⁸³ Also, the “food stamp cycle” of receiving stamps just once a month in the beginning, and a decline in benefits over the time of distribution, could lead to periods of overconsumption and underconsumption and alternating patterns of energy intakes have been linked to overweight.²⁰

The studies that link SNAP participation and obesity may serve as a proxy measure for food choices; however, these are confounded by variables of demographics, food insecurity, poverty, and self-selection. It has been documented that SNAP participation ensures an adequate quantity of food but may or may not ensure the quality of food purchased and consumed.⁴³ Participants have shown increased consumption of sources of added sugars and solid fats.^{44,47,55} Nevertheless, the results should be interpreted with caution since these cross-sectional studies^{84,85} consider data at one point in time,^{60,61,84} but weight gain results from long-term imbalances of energy.⁶⁶ Relatively few studies have investigated the effect of duration of the participation and obesity.^{62,63,67,70,73} Also, many factors may confound the association between exposure to SNAP and the risk for obesity such as duration of exposure and amount of benefits received. Further, differences might exist in the characteristics of people who participate for longer periods vs those that enroll for a shorter duration. Future studies could use statistical techniques such as random-effects model to address the problem of bias with self-selection into the program for varying durations.

Although the data on the increased consumption of SSB's in SNAP vs non-SNAP are inconclusive, the unrestricted purchase of SSB's with SNAP benefits may have contributed to this increased trend of consumption. Policymakers have proposed imposing sales taxes on SSBs or restricting purchase of these beverages with SNAP benefits.⁸⁶ A study used point-of-sale data from 58 stores to estimate the changes in demand on taxation of sugar-sweetened among SNAP users.⁸⁷ The taxation of SSBs reduced purchase and shifted focus toward non-taxed beverages of bottled water and milk.⁸⁷ The implications of restricting the purchase of SSB's through SNAP funds also are unclear. On the contrary, it is plausible that some SNAP recipients might shift on to using their own cash to purchase these items,⁸⁸ or food manufacturers may create similar drinks with the same added sugar composition, which would not fall under the restricted category.⁸⁹ In addition, it is unknown whether there is a significant difference in soda consumption between SNAP participants and nonparticipants that extends beyond the risk linked to poverty.⁹⁰ More demonstration projects or pilot studies are warranted in order to obtain evidence on how such restrictions would affect choices for SSB.

Another point of consideration is that SNAP provides benefits for food purchases and not actual cash. The Southworth hypothesis provides distinctions between two groups of food stamp coupon recipients: inframarginal recipients, or those that have food expenditures higher than the value of the coupon benefits, and extramarginal recipients, whose food expenditures are less than or equal to the value of their coupon benefits.⁹¹ The hypothesis maintains that inframarginal recipients should choose the same amount and type of goods whether they receive food stamps or cash.⁹¹ Research on the Southworth hypothesis is inconclusive, with some investigations in support^{92,93} and other against this system.^{94,95} In an investigation by Lusk et al, in-kind transfers had a similar effect on food purchasing patterns as an unrestricted cash transfer for inframarginal consumers, but expenditures on food were higher for in-kind than cash transfers for extramarginal consumers.⁹⁶ In the same study, which had a restriction on the purchase of SSBs with SNAP benefits, those who always purchased soda did so even after the restriction. They reported rearranging items purchased in cash or kind, with no extra cost. Thus, an increase in the food income through SNAP benefits or restriction of purchase of certain food items such as SSBs with SNAP benefits, might lead to varying purchasing patterns in different types of consumers.

Behavioral economic strategies to encourage SNAP recipients to select healthy choices could reduce cost of healthy foods,⁹⁷ providing monetary benefits for the purchase of healthy foods,⁹⁷ increasing the SNAP benefits, issuing SNAP benefits twice a month,⁹⁸ incentivizing small food retailers to offer more food choices in low-income neighborhoods,⁹⁸ increasing grocery stores and supermarkets in poor neighborhood and strengthening the SNAP-Ed program. Establishing supermarkets in low-income areas can be both costly and time-consuming.⁹⁹ Also, a lack of transportation can still constitute a major barrier to accessing the supermarkets, thereby increasing the dependence on corner stores in low-income areas.¹⁰⁰ Significantly higher purchase of unhealthy foods has been associated with shopping at corner stores as compared to that at the supermarkets.¹⁰¹ Results from the Baltimore Healthy Stores pilot project indicate that interventions targeted toward strengthening small food-based stores are effective in increasing healthy food availability in low-income neighborhoods.¹⁰⁰

Which of the above strategies would be most effective is unclear, but economic incentives are certainly desirable. The USDA estimated that a decrease in the price of fruits and vegetables by 10%, would increase purchases of fruits and vegetables by 6–7% in SNAP participants.³⁸ Blumenthal et al, surveyed 1250 individuals who had stakeholder interest in SNAP from different fields such as academia, advocacy groups, government, and the food industry.¹⁰² Respondents proposed the use of incentives in the form of vouchers and coupons to purchase healthy foods. An example of providing an economic benefit is seen in the Healthy Incentives Pilot randomized trial. The SNAP participants received 30 cents on every one dollar they spent on the targeted lists of fruits and vegetables.¹⁰³ This resulted in a 26% increase in consumption of these foods.¹⁰³ Another such initiative was the Double Up Food Bucks Program, in which SNAP participants received a \$10 gift card, when they spent \$10 on the purchase of fruits and vegetables in a single transaction. This program resulted in a rise in expenditure on fruits and vegetables by \$0.40 per month. However, the effect deteriorated on withdrawal of the financial incentives, thereby indicating that the program did not produce long-lasting effects on the food choices and purchasing behaviors of the participants.¹⁰⁴

Another suggestion is that an escalation in the total SNAP benefits would increase the spending on food in general. Greater spending on food is associated with

higher consumption of fruits and vegetables for both SNAP participants and eligible nonparticipants.⁴⁰ Lin et al, observed a rise in the consumption of fruits and vegetables with additional SNAP income, but the total intake was still below recommended levels. It is unclear whether an increase in SNAP benefits would result in greater consumption of these foods to match the level of the dietary recommendations.

The Farm Bill of 2014 requires SNAP-authorized retail stores to offer a larger variety of healthy food options.⁹⁸ This provision will increase the access and availability of healthy foods to the beneficiaries. Yet, there might be problems associated with this approach as SNAP recipients may not be inclined to purchase these items, which may levy an economic strain on the retailer.⁹⁸ Finally, increasing the availability of supermarkets and grocery stores in low-income neighborhoods may also be effective in reducing dependence on convenience stores or gas stations that do not offer adequate healthy food choices.⁹⁸

There are some actions that can be taken by the government to improve the adequacy of the SNAP. One such action is to replace the TFP with the Low-Cost Food Plan.¹⁰⁵ TFP is based on a national average of food prices; however, there is a wide variation in the food prices across the nation. As a result, higher food prices may limit the affordability of a healthy diet with the same SNAP benefits as compared to participants living in areas where food prices are low.¹⁰⁵ Low-Cost Program is approximately 30% higher than the TFP, depending on household composition.¹⁰⁵ Although the Low-Cost Food Plan, shares many limitations of the TFP, it is more in aligned to what low- and moderate-income families spend on food.¹⁰⁵ In addition, it provides greater food choices for healthy foods.¹⁰⁶

The current practice of the distribution of SNAP benefits is that they are received once a month and most of the funds are used in the first two weeks of receiving them. This pattern promotes the purchase of packaged goods that have a longer shelf life and can be used on a later date. A bi-monthly distribution of benefits may increase the purchase of perishable food items, and reduce the decline in diet quality by the end of the month.⁷⁶

Encouraging alternate retailers such as mobile markets/vans and community gardens, which can increase access to healthy food options for groups who lack or have limited transportation for grocery shopping at supermarkets.¹⁰²

Another promising strategy is strengthening SNAP-Ed, the nutrition education programs funded through SNAP.

Two demonstration projects were undertaken by the USDA to increase the consumption of fruits and vegetables in SNAP recipients. The Building and Strengthening Iowa Community Support program delivered nutrition and physical activity education to elementary school children,¹⁰⁷ while the Michigan State University Extension's Eat Smart, Live Strong program provided education to low-income seniors.¹⁰⁸ Both these programs increased the consumption of SNAP recipients for fruits and vegetables by 0.24 cups in children and 0.52 cups in the seniors, respectively.¹⁰⁸ Thus, expansion of SNAP-Ed could play a valuable role in improving nutrition knowledge on understanding food labels, choosing healthy sources of macronutrients and micronutrients in the diet, identification of sources of added sugars, and ways to prepare balanced meals.¹⁰⁹

Key research gaps

There is a lack of investigations that directly investigate food choices in SNAP participants. This research reviewed and summarized evidence on food choices as assessed from proxy measures of food expenditures, diet quality, and obesity in SNAP participants. However, this might not be the best approach as food choices are influenced by a number of individual, demographic, and socio-economic factors.

There was a wide diversity in the studies reviewed in terms of the design and sample sizes. They ranged from focus groups, convenience samples, national samples, cross-sectional studies to economic projection investigations. While focus group studies are qualitative in nature, cross-sectional studies could provide limited quantitative evidence on the causal relationship between SNAP participation and diet quality or obesity. However, this review has included a grading system to evaluate the grading of the evidence regarding different outcomes to provide more transparency and structure to the review.

There was a lack of consensus on the definitions and standards for measurements of outcomes such as diet quality. Diet quality is measured using different questionnaires and tools, making the standardization and interpretation of results difficult. These inconsistencies made it difficult to combine results across studies.

In summary, future research should use case-controlled or prospective study designs in low-income individuals to investigate the effects of participation in SNAP on food choices.

Conclusions

The SNAP in the US serves as an important safety net program for millions of low-income Americans. As such it has the potential to impact food choices and dietary intakes of a large segment of society. However, food choices are guided by factors other than socio-economic and demographic characteristics. These include human behavior with the biological propensity to eat foods high in sugar, salt, and fat. In addition, there are significant missed opportunities that limit the full potential of SNAP to promote the consumption of nutritious foods by SNAP recipients. Certain immediate steps can be taken by the government. These include replacing the TFP with the Low-Cost Food Plan; changing the pattern of distribution of SNAP benefits to bi-monthly; incentivizing food retailers to offer more food choices in low-income neighborhoods; encouraging mobile vendors to provide healthy foods to individuals who lack transportation; and strengthening the SNAP-Ed program. Finally, it would be beneficial to support pilot and demonstration projects to obtain evidence on policies of limiting SNAP benefits for the purchase of unhealthy foods.

Acknowledgments

This research was funded by the Bess Heflin Centennial Professorship #3086006875. The funder provided funds for conducting the study.

Disclosure

The authors report no conflicts of interest in this work.

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