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Review Article

Interventions targeting diet quality of Supplemental Nutrition Assistance Program (SNAP) participants: A scoping review

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ABSTRACT

The national Supplemental Nutrition Assistance program (SNAP) has been successful in reducing food insecurity among low-income Americans. However, the program has also been criticized as unhealthy food choices, and rates of diet-related chronic diseases remain high among SNAP beneficiaries. Recently, several multi-component interventions have targeted SNAP beneficiaries, aiming to improve how benefits are utilized to support a healthful diet. The aim of this scoping review is to examine the breadth of published interventions that have targeted SNAP beneficiaries, and their reported impact on diet and nutrition related outcomes. Using key search terms, a literature search of government and peer review databases was conducted. Twelve unique interventions were identified and categorized based on the type of intervention delivered: 1) monetary incentives 2) nutrition education, and 3) combined nutrition education plus monetary incentives. Across all interventions, monetary interventions showed modest improvements in reported fruit and vegetable intake among SNAP beneficiaries. While nutrition education interventions showed improvement in psychosocial correlates of diet, changes in dietary intake were inconsistent. Combination programs demonstrated the strongest improvements in dietary change among beneficiaries. Variability in types of outcomes measured limits comparability of findings across studies, and our findings calls for further evaluation in this area. This scoping review suggests using financial incentives combined with nutrition education may be effective in improving dietary intake among SNAP beneficiaries. Future research should integrate more robust study designs and consider multiple levels of intervention to effectively change beneficiary habits and in turn, reduce diet related disease in this population.

1. Introduction

The Supplemental Nutrition Assistance Program (SNAP), formerly known as Food Stamps, is the largest federal nutrition aid program in the United States (US). In 2016, 21.8 million households received SNAP benefits, and 65% of these households had a child, an elderly individual, or a person with disability (Lauffer, 2017). The goal of the SNAP program is to reduce food insecurity, defined as "the uncertainty of having or inability to acquire enough food to meet the needs of a household due to insufficient money or other resources for food" (USDA, 2017).

Both food insecurity and nutrition-related illnesses impact lower socioeconomic groups. Nearly one third (31.6%) of households with income below 185% of the poverty threshold are food insecure (Coleman-Jensen et al., 2017); diet-related diseases including obesity, type 2 diabetes, cardiovascular disease and hypertension are disproportionately higher in the same population (Larson and Story, 2011; Parker et al., 2010). Therefore, issues of both food insecurity and over-nutrition paradoxically impact the same group of low-income Americans. This overlap highlights the need for assistance programs that encourage healthy eating. SNAP benefits can currently be used to purchase any food, garden seeds, or non-alcoholic beverage from eligible retailers, regardless of nutritional content (USDA, 2012). Although such rules allow for greater flexibility, SNAP has been criticized for allowing unhealthy food purchasing practices among beneficiaries, and data suggests SNAP participants buy fewer fruits and vegetables, as well as more sugar-sweetened beverages compared to those not receiving SNAP (Andreyeva et al., 2012; Gustafson, 2017).

In response to these intersecting public health issues of chronic disease and food insecurity among SNAP participants, multi-component interventions have been developed to target both nutrition education and access to more nutritious foods among beneficiaries. To identify the best strategies for health promotion in this population, the Food, Nutrition and Conservation Act of 2008, also known as the 2008 Farm Bill, authorized $20 million for pilot projects to implement interventions targeting increased fruit, vegetables or other healthful food purchasing among SNAP participants (USDA 2017a). To our knowledge, no reviews have been conducted to evaluate the scope of these interventions. Given that SNAP is scheduled to be reauthorized in the 2018 Farm Bill, a synthesis of the current literature on interventions targeting SNAP beneficiaries is timely and crucial to inform policy efforts in this area. The purpose of this scoping review is to identify interventions targeting SNAP participants and assess the impact of these interventions in improving dietary habits.

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2. Methods

A scoping review is designed to address a broad research question, identify relevant evidence concerning the issue, produce summaries of findings (Colquhoun et al., 2014; Levac et al., 2010) and provide direction for future research and policy (Arksey and O'Malley, 2005; Levac et al., 2010). A modified Arksey and O'Malley framework was used to guide this scoping review (Arksey and O'Malley, 2005). The framework is comprised of the following methodological steps: 1) identifying the research question; 2) identifying the relevant studies; 3) study selection; 4) charting the data; 5) collating, summarizing and reporting the results. This approach was adapted for the review and further supplemented with improvements suggested by Levac et al. (2010).

A literature search of articles was conducted in June 2017 through September 2017. A search strategy was developed and supervised by a research librarian with experience in conducting scoping and systematic reviews. Key search terms included: Supplemental Nutrition Assistance Program, Food Stamp, SNAP, healthy eating, sugary drinks, fruit, vegetables, nutritional quality, diet, nutrition policy. The electronic databases PubMed, Ovid Medline, EMBASE, SCOPUS and the United States Department of Agriculture website (USDA) were utilized for this review. Peer-reviewed research studies and governmental reports published on the USDA website were examined. Inclusion criteria were: (1) intervention should specifically target SNAP participants, (2) outcomes assessed were nutrition-related (e.g. fruit and vegetable intake, food purchased, nutrition related behaviors), (3) studies published only in English. Exclusion criteria were: (1) target population that were non-SNAP participants, (2) non-intervention studies (3) if SNAP itself was the intervention, and (4) if outcome measures did not relate nutrition and related psychosocial behaviors. No limitation on publication date was imposed.

Study selection was undertaken using a multi-step screening process (Fig. 1). Studies retrieved using the search strategy were first combined and duplicates removed. Unique studies were screened based on title to identify and exclude irrelevant publications. Two reviewers (first and second author) independently assessed the abstracts and full texts of remaining studies for inclusion based on the criteria outlined above.

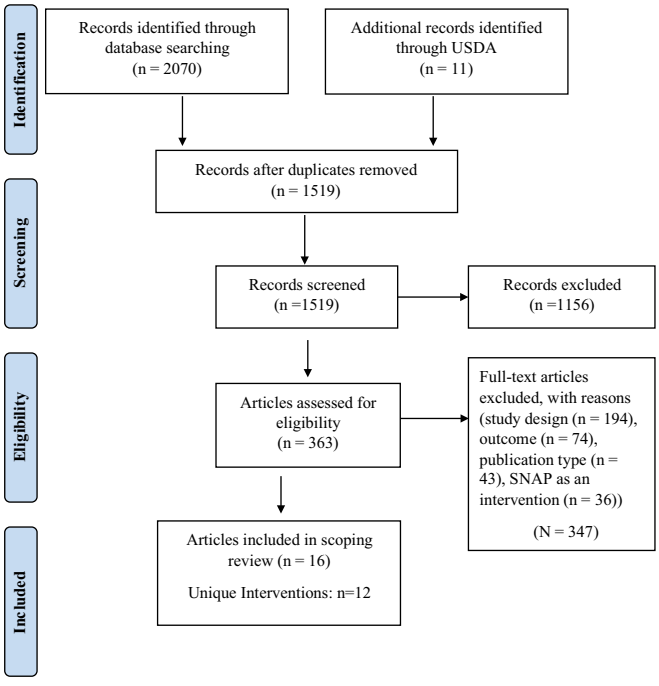

Fig. 1. Study selection process.

There was 96% agreement between the two reviewers and disagreement was resolved through discussion and mediation by the senior author. No human subject research was conducted as part of this review, so approval from the institutional review board was not obtained.

Components for each type of intervention were examined, and impact on nutritional outcomes were assessed for each included study. Study author, location, design, length, primary aim, outcome measures and results were extracted from publications and presented in table format. Studies were appraised for risk of bias through an examination of common markers of study quality including the use of a control group, randomization, blinding, completeness of data, and any notable bias or selective reporting.

3. Results

The search strategy identified 1519 unique articles (Fig. 1). After the initial titles were screened, 363 articles were retrieved for abstract/full text review. Of those, 16 articles met the inclusion criteria. Several publications were secondary analyses of included studies, so they were combined with the principal publication. This resulted in a total of 12 unique interventions to be included in this review. A summary of study characteristics is presented in Table 1. Risk of bias for included studies is shown in Table 2.

Seven interventions exclusively targeted SNAP participants (Bartlett and Abt Associates, 2014; Campbell et al., 1999; Cohen et al., 2017; Collins and Klerman, 2017; Kim et al., 2011; Klerman et al., 2014; Olsho et al., 2016; Savoie-Roskos et al., 2016; Tobey et al., 2016; Wilde et al., 2016). Two interventions targeted both SNAP and Special Supplemental Nutrition Program for Women, Infants and Children program (WIC) participants (Bowling et al., 2016; Gordon et al., 2017). Four interventions targeted SNAP and SNAP eligible participants combined (Hersey et al., 2015; Kaiser et al., 2015; Savoie et al., 2015; Young et al., 2013). There was variation in study size from small, convenience samples to large national samples ($N = 54$ to $N = 55{,}095$). We stratified the studies into three categories based on the types of intervention strategies used: 1) monetary incentive (n = 6), 2) nutrition education only (n = 6), and 3) monetary incentive plus nutrition education (n = 1).

3.1. Monetary incentive interventions

Monetary incentive interventions offered rewards or rebates to participants in order to offset the cost of healthier foods and reward more nutritious food purchasing choices. Six studies examined monetary interventions for SNAP participants. Three general types of monetary interventions strategies were used including 1) Health Incentives Pilot program (HIP), 2) Summer Electronic Benefit Transfer for Children (SEBTC) and 3) farmer's market incentives. Studies evaluating HIP (Bartlett and Abt Associates, 2014; Klerman et al., 2014; Olsho et al., 2016; Wilde et al., 2016) and SEBTC (Collins and Klerman, 2017; Gordon et al., 2017) used a randomized controlled trial design. Studies evaluating the impact of farmers' market incentives used longitudinal repeated measures, cross-sectional, or pre–post (no control) study designs (Cohen et al., 2017; Savoie-Roskos et al., 2016; Young et al., 2013).

3.1.1. Healthy Incentives Pilot Program (HIP)

The HIP study was one-year randomized controlled trial conducted in Massachusetts (Bartlett and Abt Associates, 2014; Klerman et al., 2014; Olsho et al., 2016; Wilde et al., 2016). The experimental group (n = 7500) was provided a 30% rebate on purchases of targeted fruits and vegetables (TFV) (TFVs included fresh, frozen, canned and dried fruits and vegetables without added sugars, fats, oils or salt and excluded white potatoes and fruit juice) at participating retailers, while the control group (n = 47,595) received regular SNAP benefits (Bartlett and Abt Associates, 2014; Klerman et al., 2014; Olsho et al., 2016;

Table 1
Summary of studies.

Author	Year of publication	Year of study	Duration of study	Location	Study design	Study pop
Bartlett et al., Klerman et al., Olsho et al., Wilde et al	2014 2014 2016 2015	2011–2012	12 months	Hampden County, MA	Randomized controlled trial	SNAP households (N = 55,095) HIP group = 7500; non-HIP group = 47,595
Bowling et al	2016	2013	17 weeks	Providence, Rhode Island	Pre-post	WIC household - 110 SNAP household - 108
Campbell et al	1999	1995	One time − 30 min session, resurveyed 1–3 mths post intervention	North Carolina	Randomized control	Women using food stamps (N = 165 intervention + 212 control = 377)
Cohen et al	2017	2014–2015	5 mths	Michigan	Longitudinal repeated measures quasi-experimental	Adult SNAP beneficiaries (N = 127)
Collins et al	2017	2012	Summer of 2012	5 states in US(8 sites)	Randomized controlled	SNAP households only (N = 9124) (4510 benefit grp + 4614 control grp)
Gordon et al	2016	2012	Summer of 2012	8 states & 2 Indian tribal organization	Randomized controlled	SNAP/WIC households with school children (N = 27,092 households) SNAP = 16,225 & WIC = 10,867
Hersey et al	2015	2012	4 weeks March-May	Michigan	Nonrandomized controlled	60–80 yr old SNAP & SNAP eligible; final N = 603 intervention = 263, control = 340;
Kaiser et al	2015	2011–2013	4 lessons in one month over 2011–2013	California	Pre-post	SNAP & SNAP eligible participants in California 2011–2012 (N = 1371, 63% in SNAP) & 2012–2013 (N = 2371, 54% in SNAP)
Kim et al	2011	2010	June-Aug	Alabama	Pre-post	SNAP recipients (N = 176)
Savoie et al	2014	2012	1 lesson	Utah	Retrospective post then pre-test	SNAP & SNAP eligible participants (N = 186)
Savoie-Roskos et al	2015	NA	4 weeks	Salt Lake City, Utah	Pre-post	SNAP participants (N = 54)
Tobey et al	2016	2009	2 months	5 Oregon counties	Non randomized controlled	SNAP participants (N = 2028)
Young et al	2013	2011	Sept -Nov	Philadelphia PA	Cross-sectional	SNAP & SNAP eligible population (N = 608)Philly Buck users vs nonusers

Author	Aim/objective	Intervention	Monetary intervention	Resurveyed	Outcome measures	Results	Funding
Bartlett et al., Klerman et al., Olsho et al., Wilde et al	To assess the causal impact of HIP on F& V intake & other measures of dietary intake. Secondary objective: to assess expenditure on targeted & all F&V.	Health Incentives Pilot (HIP) program	HIP rebate - 30% rebate on purchase of targeted F&V when using SNAP benefits at participating retailers. Rebate capped at $60.	4–6 months and 9–11 months after intervention	Survey (demographics), USDA's automated multiple pass method(24 h diet), modified version EATS Fruit & Vegetable Screener (F&V consumption), EBT transaction data using Xerox, participant focus group	Intervention group (adults): Statistically •Higher intake in targeted F&V/day (p = 0.001); all F&V intake (p < 0.001); 100% fruit juice intake (p = 0.009) •Lower intake of refined grain (p = 0.002) •Higher expenditure on targeted F &V: (p < 0.001). •Higher SNAP purchases (p < 0.001) •Higher impact on total HEI-2010 score (p < 0.001) than control group •No statistical difference between early implementation and the late implementation (p = 0.653)	USDA FNS funds
Bowling et al	To examine feasibility and efficacy of the "Healthy Foods for Healthy Families" (HFHF) nutrition education program.	Monthly: Healthy cooking demonstrations Weekly: nutritional literacy activities &, taste tests for children, & recipe cards & education materials for adults	Every third week attendance: $20 in Bonus bucks for purchase of F & V at farmers' markets (limited to $120 per family per season) Weekly: 40%EBT card bonus	Midseason survey after 1 month, exit survey- last 4 weeks	Enrollment forms (demographics), pre & post survey (self-reported participation objectives, F&V/ soda intake, food spending patterns, & barriers to participation)	•75.2% of enrolled families completed at least 3 visits to farmers market. •Statistically increased intake of vegetable (p = 0.005) •Statistically lower intake of soda (p = 0.005) •Marginal increase in fruit intake. •No change in WIC/SNAP budget spent on F&V.	Blue Cross Blue Shield of Rhode Island, the Van Beuren Charitable Foundation, The Fresh Sound Foundation, Seven Stars Bakery & CVS Caremark

Table 1 (*continued*)

Author	Aim/objective	Intervention	Monetary intervention	Resurveyed	Outcome measures	Results	Funding
Campbell et al	To determine the impact of StampSmart, a multimedia program on nutrition knowledge, self- efficacy, stage of change and dietary fat intake.	Tailored soap opera & interactive "info-mercial" that incorporated strategies to increase self-efficacy regarding low fat eating & advance through stages of change + stamp smart low fat recipe book	None	1–3 months	Enrollment forms (demographics) paper survey & telephone survey (stage of change, self-efficacy, knowledge), 16-item food frequency questionnaire (dietary fat score)	•No statistical significant difference in dietary fat intake between intervention & control group •Statistical difference in knowledge of low fat foods in intervention & control group ($p < 0.001$) •No sustained statistical significant difference in self-efficacy •Higher percentage of intervention group advanced in stage compared to control group ($p = 0.01$)	USDA grant, Food Lion Inc., & Quaker Foundation
Cohen et al	To evaluate if a brief waiting room based informational promoting DUFB would increase DUFB utilization & F&V consumption	Informational promoting Double up Food buck at Farmers market-DUFB	DUFB - 1:1 match up to $20 per visit	1.5 month, 3 month, 5 month	Enrollment forms (demographics) self-reported paper & semi structured survey (DUFB usage & frequency), validated 2 item FV instrument (F & V consumption at baseline, midpoint & 2 months after DUFB season)	•Significant increase in farmers' market visit ($p < 0.001$) •Significant adjusted F&V intake increased from baseline at 3 mths ($p < 0.001$) & at 5 mths ($p < 0.001$).	Robert Wood Johnson Foundation Clinical Scholars Program and WK Kellogg Foundation
Collins et al	To determine the impact of SEBTC + SNAP on food expenditure, food security and nutritional outcomes in children	Summer Electronic Benefit Transfer for Children (SEBTC)	$60.00 per eligible school aged child	30 days after benefits started	Survey (demographics) USDA's 18 item U.S Household Food Security Survey Module (food security), National Health & Nutrition Examination Survey Multifactor Diet Screener (Children's dietary outcomes)	•Reduced VLFS in children by 34% and in adults by 36%. •SEBTC children had statistically higher intake of F &V intake ($p < 0.0001$), F&V without fried potatoes ($p < 0.0001$), dairy servings ($p < 0.0001$) •No statistical difference in added sugar, sugar sweetened beverages and added sugar excluding cereal.	USDA FNS funds
Gordon et al	To determine the difference in program take up & impacts between the household served in SEBTC sites using SNAP & WIC benefit distribution models.	Summer Electronic Benefit Transfer for Children (SEBTC)	$60.00 per eligible school aged child	30 days after benefits started	Survey (demographics),EB-T records(benefit redemption), 30 day food security measure (food security), National Health & Nutrition examination Survey Dietary Screener Questionnaire for children(diet quality)	•Benefit redemption: 98% SNAP sites vs 84% WIC sites. •Statistical significant reduction of VLFS ($p < 0.01$) & FI ($p < 0.01$) in WIC & SNAP SEBTC groups •Food intake impact: WIC SEBTC children had statistically higher intake in F & V ($p < 0.01$); F & V without fried potatoes ($p < 0.01$); whole grains ($p < 0.01$); dairy ($p < 0.01$) •Statistically lower intake in added sugar excluding cereal ($p < 0.01$); sugar sweetened bev ($p < 0.01$); added sugar ($p < 0.05$) than SNAP SEBTC	USDA FNS funds

Table 1 (*continued*)

Author	Aim/objective	Intervention	Monetary intervention	Resurveyed	Outcome measures	Results	Funding
Hersey et al	To determine if ESLS would increase the participants consumption of fruits and vegetables	Eat smart live strong curriculum	None	1–2 weeks after 4 week intervention	Survey (demographics) (University of California Cooperative Extension Food Behavior Checklist (cups of F&V consumed)	•Statistical increase in intake of cups of fruit ($p < 0.05$); cups of vegetable: ($p < 0.01$); cups of F&V: ($p < 0.01$)	USDA FNS funds
Kaiser et al	To determine if Plan, Shop, Save and Cook class series helped increase food resource management skills and running out of food at the end of the month	Plan, Shop, Save and Cook - 4 class series.	None	Follow up at end of lesson 4	Demographic form (demographics) pre-post questionnaire (food resource management & food security)	•ROF reduction: 33.4% of participants in 2012 & 38.3% in 2013 •Correlation between resource management & reduction in ROF was stronger in SNAP participants ($p = 0.001$) vs SNAP eligible participants ($p = 0.01$)	USDA SNAP-Ed; USDA/National institute of Food & Agriculture Project; University of California & Natural Resources
Kim et al	To empirically test the antecedents of behavioral intention in vegetable consumption and to find a strategy to boost vegetable consumption.	Recipe cards with vegetable recipes. (4 recipe cards)	None	1 week after getting the recipe card	Self- administered questionnaire (demographics, behaviors, intention, attitude, subjective norm and perceived control)	•The stronger positive attitude toward consuming vegetables that people have, the more positive behavior of consuming vegetables they will demonstrate •95% of the participants felt they would like to eat more vegetables after making the recipes on the recipe card.	USDA SNAP-Ed
Savoie et al	To assess whether participation in selected SNAP-Ed lessons had an impact on nutrition related behaviors on participants.	Utah's SNAP - Ed cooking basics curriculum - Menu Planning lesson OR MyPlate lesson	None	Before and after each lesson	Questionnaire (demographics, intention to change nutrition related behavior)	•After Menu Planning lesson or My Plate lesson participants reported change in intentions from "sometimes engaged" in the specific nutrition related behavior to "usually engaged" in nutrition related behaviors ($p < 0.001$).	Not disclosed
Savoie-Roskos et al	To determine whether double-up bucks farmers' market incentive program improved food security & F& V intake among SNAP participants	Double-up food bucks program (DUFB)	DUFB - 1:1 match up to $10 per week	End of 4 weeks	Survey (demographics, food assistance, and shopping habits) modified 6 item F& V module of BRFSS (F&V consumption), 6 item security module (food security)	•Mean food insecurity score decreased statistically ($p < 0.05$) •Statistical increase in intake of other vegetable ($p = 0.001$). •No statistical change in total F&V score.	Not disclosed
Tobey et al	To determine if a multi-channel, targeted segmented short social marketing campaign would increase positive beliefs about F&V intake.	Food Hero Social marketing campaign	None	End of 2 month campaign	Survey (demographics) Focus group (beliefs & barriers to F V intake), Phone Survey (FV intake, beliefs & barriers to FV intake)	•Control group had lower confidence in serving balance meals for their family ($p = 0.03$) •Less likely to report canned fruit is as healthy as fresh fruit (P 0.01) •Statistical post-intervention improvement in the intervention group in these beliefs: it is easy to get my family to eat fruit ($p = 0.005$) •Less likely to report eating a diet that includes a lot of F & V as expensive ($p = 0.0005$) •Less likely to report that it is time consuming to prepare a healthy meal ($p = 0.005$)	Oregon SNAP Ed

Table 1 (*continued*)

Author	Aim/objective	Intervention	Monetary intervention	Resurveyed	Outcome measures	Results	Funding
Young et al	To determine if Philly Food Bucks increased F&V intake and increase SNAP sales at farmers market in low income areas.	Philly Food Bucks at farmers markets	$2.00 bonus coupons redeemable only for fresh F&V for every $5 in SNAP benefits used	Onetime survey	Survey (demographics, change in dietary behavior, shopping frequency), Philly Bucks & SNAP sales data	•Philly Food Buck users were significantly more likely to report eating more F& V than nonusers ($p < 0.001$) •Philly Food Buck users were significantly more likely to try new or unfamiliar F/V ($p = 0.006$) •Average SNAP sales per market increased from $1036 in 2009 to $2382 in 2011	Centers for Disease Control & Prevention (CDC), Communities Putting Prevention to Work.

HFHF - Healthy Foods, Healthy Families; F&V - Fruits and Vegetables, DUFB - Double Up Food Bucks; EATS - Eating at America's Table Study fruit & vegetable screener; BRFSS - Behavior Risk Factor Surveillance System; ROF - Running out of Food; VLFS - Very Low Food Security; FI - Food Insecurity.

Wilde et al., 2016). Four publications evaluated the impact of HIP across multiple diet-related outcomes including adult dietary intake and SNAP benefit spending. Study authors reported a significant increase in TFV intake among adults in the intervention group a quarter cup higher compared to the control group ($p < 0.001$) (Bartlett and Abt Associates, 2014; Klerman et al., 2014; Olsho et al., 2016; Wilde et al., 2016). Significant increases in intake in total fruit ($p = 0.005$), total vegetable ($p < 0.001$), and all fruits and vegetables (0.32 cup equivalent; 95% CI: 0.17, 0.48) ($p < 0.001$) were observed among adults in the intervention group (Bartlett and Abt Associates, 2014; Klerman et al., 2014; Olsho et al., 2016). However, there was also a significant 21% increase in untargeted 100% fruit juice intake in the intervention group compared to controls ($p = 0.009$) (Bartlett and Abt Associates, 2014; Olsho et al., 2016). HIP intervention participants demonstrated a significant decrease in refined grain intake compared to controls ($p = 0.002$) (Bartlett and Abt Associates, 2014; Olsho et al., 2016). Mean monthly SNAP spending was higher in the intervention group as compared those in the control group, mainly due to the incentives earned ($p < 0.001$) (Bartlett and Abt Associates, 2014; Wilde et al., 2016). Electronic Based Transaction (EBT) records showed average spending on TFV in participating stores was $12.05 in the intervention group vs $10.86 in the control group, and the average incentive earned was $3.65 (Bartlett and Abt Associates, 2014).

3.1.2. Summer Electronic Benefit Transfer for Children (SEBTC)

The SEBTC incentive program included $60 incentive per eligible child per month and was delivered either through the WIC or SNAP electronic benefit transfer (EBT) system (Collins and Klerman, 2017; Gordon et al., 2017). Incentive purchasing had to follow the allowable food guidelines of each program (Collins and Klerman, 2017; Gordon et al., 2017). Control participants did not receive this additional benefit (Collins and Klerman, 2017; Gordon et al., 2017). A total of 42,000 households with school-aged children eligible for the National School Lunch/Breakfast program were randomly assigned to a control group or SEBTC group (Collins and Klerman, 2017; Gordon et al., 2017). Two studies evaluated the SEBTC intervention during the summer of 2012. One study addressed the impact of SEBTC on family food expenditure, food security, and child nutritional outcomes among SNAP study participants (Collins and Klerman, 2017). Another study compared differences in impact of SEBTC between SNAP and WIC intervention sites (Gordon et al., 2017). Outcome measures include household food security, and dietary intake of children (Collins and Klerman, 2017; Gordon et al., 2017).

Collins & Klerman reported that children in SNAP recipient households receiving the SEBTC benefit demonstrated significantly increased intake of total fruit and vegetables ($p < 0.0001$), fruit and vegetables without fried potatoes ($p < 0.0001$), dairy ($p < 0.0001$) and whole grains ($p < 0.05$) compared to the control group (Collins and Klerman, 2017). However, neither group met the recommended daily servings of fruits or vegetables (Collins and Klerman, 2017). There was no significant difference between the control and the SEBTC group in added sugar, added sugar excluding cereals, or sugar sweetened beverage intake (Collins and Klerman, 2017).

Gordon et al., reported that SEBTC benefits lowered Very Low Food Security and Food Insecurity levels in both WIC and SNAP households ($p < 0.01$) (Gordon et al., 2017). Children in WIC households demonstrated higher intake of fruit and vegetables ($p < 0.01$), fruit and vegetables without fried potatoes ($p < 0.01$), whole grains ($p < 0.01$), and dairy ($p < 0.01$) than children in SNAP households (Gordon et al., 2017). Further, children in WIC households had significantly lower added sugar ($p < 0.05$), added sugar excluding cereals ($p < 0.01$), and sugar sweetened beverage ($p < 0.01$) intake than the children in SNAP households, potentially due to the more restrictive WIC allowable foods guidelines (Gordon et al., 2017).

Table 2
Risk of bias in included studies.

Author, year	Control Grp	Randomization	Blinding	Incomplete outcome data addressed	Free of selective reporting	Free of other bias	Study arm were similar
Bartlett et al., 2014 Klerman et al., 2014 Olsho et al., 2016 Wilde et al., 2016[a]	Yes	Yes	No	Yes	Yes	No	Yes[b]
Bowling et al., 2016	No	No	No	Yes	Yes	No	NA
Campbell et al., 1999	Yes	Yes	No	Yes	Yes	No	Yes
Cohen et al., 2017	No	No	No	Yes	Yes	No	NA
Collins and Klerman, 2017	Yes	Yes	Unclear	Yes	Yes	No	Yes
Gordon et al., 2017	Yes	Yes[c]	Unclear	Yes	Yes	No	Yes
Hersey et al., 2015	Yes	No[d]	No	Yes	Yes	No	Yes
Kaiser et al., 2015	No	No	No	Yes	Yes	No	NA
Kim et al., 2011	No	No	No	Yes	Yes	No	NA
Savoie et al., 2015	No	No	No	Yes	Yes	No	NA
Savoie et al., 2015	No	No	No	Yes	Yes	No	NA
Tobey et al., 2016	Yes	No	No	Yes	Yes	No	No
Young et al., 2013	Yes	NA	No	Yes	Yes	No	No

[a] Grouped together as they are different analysis of the same study.
[b] Evaluation sample was similar but mean adult in household & unemployment compensation was significant at 0.05.
[c] Randomization at the individual level,

3.1.3. Farmers' market incentives

Farmers' market incentive programs aimed to promote attendance and produce purchasing at farmers markets among SNAP beneficiaries. Double Up Food Bucks (DUFB), included dollar-for-dollar matches for farmers market purchases up to $20 in Michigan (Cohen et al., 2017) and up to $10 in Utah (Savoie-Roskos et al., 2016). In Pennsylvania, Philly Buck $2 coupons were offered for every $5 spent (Young et al., 2013). Three articles assessed the impact of farmers' market incentives on the diet quality of SNAP participants. The main outcomes measured included participation, adult fruit and vegetable intake (Cohen et al., 2017; Savoie-Roskos et al., 2016) and purchasing behavior (Young et al., 2013).

Informational talks about DUFB in Michigan significantly increased participation in the DUFB program ($p < 0.001$) over five months, and increased adjusted fruit and vegetable intake among participants from baseline to three (0.66 serving/day; 95% CI:0.38, 0.93) and six months (0.63serving/day; 95%CI:0.34,0.92) ($p < 0.001$) in a pre-post evaluation design (Cohen et al., 2017). DUFB in Utah significantly reduced food insecurity ($p < 0.05$) and increased total intake of other (tomatoes, corn, eggplant, peas, lettuce, cabbage and white potatoes) vegetables ($p < 0.001$) but not total fruit and vegetable intake (Savoie-Roskos et al., 2016). In Pennsylvania, Philly Buck users reported higher fruit and vegetable intake than non-users (OR 2.4; 95% CI: 1.6, 3.7; $p < 0.001$), and were more willing to try new or unfamiliar fruit and vegetables than non-users (OR1.8; 95% CI: 1.2, 2.7; $p = 0.006$) (Young et al., 2013).

3.2. Nutrition education intervention

Nutrition education interventions were undertaken to educate SNAP participants on how to improve the quality of their diet and food security. Six studies used nutrition education alone as a means to improve nutrition related behaviors and diet quality of SNAP participants (Campbell et al., 1999; Hersey et al., 2015; Kaiser et al., 2015; Kim et al., 2011; Savoie et al., 2015; Tobey et al., 2016). Educational strategies were implemented in the different forms including nutrition lessons (Hersey et al., 2015; Kaiser et al., 2015; Kim et al., 2011; Savoie et al., 2015) and social marketing campaigns/infomercials (Tobey et al., 2016), (Campbell et al., 1999). Study designs varied, including one randomized controlled trial, (Campbell et al., 1999) two non-randomized control designs (Hersey et al., 2015; Tobey et al., 2016), two pre-post designs (Kaiser et al., 2015; Kim et al., 2011), and one retrospective post–pre study design (Savoie et al., 2015).

3.2.1. Social marketing/multimedia

A one-time 30-minute multimedia intervention (StampSmart) for SNAP beneficiaries resulted in significant increase in knowledge of low fat foods among the intervention group ($p < 0.001$) (Campbell et al., 1999). However, there was no significant difference but in dietary fat intake between the intervention and control group (Campbell et al., 1999).

A larger media campaign for SNAP participants called the Food Hero campaign was undertaken across five Oregon counties (4 intervention counties, 1 control county) (Tobey et al., 2016). The Food Hero comprised of targeted segments disseminated across multiple channels to increase positive beliefs about fruit and vegetable intake (Tobey et al., 2016). After the campaign, respondents across the intervention counties were more likely to report that getting the family to eat fruit was easy as compared to the control county ($p = 0.005$) (Tobey et al., 2016). Respondents in the intervention county were also less likely to report that a diet with a lot of fruits and vegetables was expensive ($p = 0.0005$), or that preparing healthy food was time consuming ($p = 0.005$) (Tobey et al., 2016).

3.2.2. Nutrition lessons

The Eat Smart Live Strong (ESLS) program included four interactive sessions of the ESLS nutrition curriculum and resulted in a statistically significant increase in participant intake of fruit ($p < 0.05$), and vegetables ($p < 0.01$) in a pre-post study design (Hersey et al., 2015). The Plan, Shop, Save and Cook program included classes focused on food resource management. SNAP participants in the four-class series reported greater reduction in running out of food at the end of the month as compared to SNAP eligible participants ($p = 0.001$) (Kaiser et al., 2015). Kim et al., offered recipe cards with vegetable recipes to beneficiaries to improve nutrition behavior (Kim et al., 2011). Evaluation surveys demonstrated that 95% of the participants reported that they would like to eat more vegetables after making the recipes on the recipe card (Kim et al., 2011). Savoie et al. examined two nutrition education programs, Utah's SNAP-Ed cooking basics/menu planning curriculum and MyPlate lessons (Savoie et al., 2015). After either

lesson, participants reported change in intentions from “sometimes engaged” to “usually engaged” in nutrition related behaviors ($p < 0.001$) (Savoie et al., 2015).

3.3. Monetary with nutrition education

Only one pre-post study (Bowling et al., 2016) examined the feasibility and efficacy of a combined nutrition education and monetary incentive program. The 17-week Healthy Foods for Healthy Families program was coupled with 40% bonus to EBT cards and extra bonus bucks every third week of intervention. The main outcomes measured included adult fruit and vegetable intake and food spending patterns. Program participants showed a significant increase in vegetable intake ($p = 0.005$), marginal increase in fruit intake ($p = 0.10$) and significant decrease in soda intake ($p = 0.005$) (Bowling et al., 2016). The majority (75%) of the enrolled families completed at least three visits to the farmers market and received an average bonus of $61. In spite of increased vegetable intake, no change in the SNAP/WIC budget spent on fruit and vegetables was reported (Bowling et al., 2016).

4. Discussion

This scoping review broadly examines published interventions that have targeted the SNAP participant population. Twelve unique interventions that offered monetary incentives, nutrition education or a combination of incentives and education were identified. Monetary interventions including HIP, SEBTC, and Farmer's market incentives showed modest improvement at varying levels in fruit and vegetable intake among the SNAP population.

HIP appeared to have had the greatest impact in improving the diet of SNAP participants by increasing fruit and vegetable intake. However, observed EBT records show that expenditures were lower than expected given the self-reported increase in TFV intake, and the average incentive earned was low. Participants noted that the program was confusing and were unsure of what purchases qualified for incentives (Bartlett and Abt Associates, 2014). With the SEBTC incentive, SNAP households earned an average of $90 more each month during the summer, and were able to reduce food insecurity, but the improvement in fruit and vegetable intake was modest (one fifth of a cup) (Collins and Klerman, 2017). The farmer's market incentives studies demonstrated moderately increased fruit and vegetable intake as well. However, national trends reveal only about 2% of SNAP households shopped at a farmer's market at least once in the past year (USDA, 2014). Publicizing the incentive program, as was done in Michigan, may help increase participation rates, which in turn may increase the rate of farmer's market visits as well as fruit and vegetable intake (Cohen et al., 2017). Taken together, these findings suggest monetary incentives for targeted foods could potentially improve diet in SNAP beneficiaries, but may be more effective if supported by public awareness/informational strategies.

Interventions that used nutrition education showed promising improvements in psychosocial correlates of health in SNAP participants. Lessons in food insecurity reduction, cooking, and goal setting led to improved resource management skills and positive behavior modification among participants. However, dietary changes were not universally demonstrated in concordance with these psychosocial improvements. Increased fruit and vegetable intake and overall diet improvement was seen when nutrition education was combined with farmer's market incentives (Bowling et al., 2016). The quasi-experimental study designs of these studies limit conclusions, but these preliminary results suggest that using nutrition education strategies combined with monetary incentives could potentially improve dietary habits among SNAP participants. More robust study designs to evaluate the impact of these interventions are needed.

Previous studies have reported that SNAP participants, on average, have lower diet quality than SNAP eligible and higher income non-participants (Andreyeva et al., 2015). The present review suggests that diet quality was only marginally impacted by the existing intervention strategies on SNAP and SNAP eligible participants. Thus, more comprehensive approaches combining improved access to healthy food with nutrition education may be needed to improve participant diet to the point of mitigating disease risk. A recent cost-benefit analysis of the HIP project reported that the fruit and vegetable incentive program would have a limited impact on weight management, disease prevention, and quality of life (An, 2015). Further, a recent randomized control trial study noted an increase in vegetable intake among study participants had limited impact in anthropometric measures after 3 months, as the increased vegetable intake did not replace energy dense foods (Kral et al., 2016). However, recent studies have shown that increased fruit and vegetable intake have been shown to have a beneficial impact in reducing morbidity and mortality in key chronic diseases like diabetes, cancer and heart disease (Aune et al., 2017; Wang et al., 2014). Nutrition interventions for SNAP participants need to consider overall dietary patterns, as opposed to just fruit and vegetable intake during program design and evaluation.

Based on this review of existing interventions, offering more restrictive guidelines on SNAP purchases may support dietary change. The SEBTC monetary incentive study examined program effects on SNAP vs WIC households and found children from the WIC households were reportedly healthier in their overall dietary intake as compared to those from SNAP households (Gordon et al., 2017). This may be due to the fact that WIC households had to follow the well-established WIC healthy nutrition guidelines on benefit redemption. This finding is in line with that of Harnack et al., who demonstrated that a financial incentive program with restriction on purchase of unhealthy foods reduced energy intake and improved overall diet in a sample of low-income individuals (Harnack et al., 2016). Restrictions on the purchase of unhealthy foods combined with incentive programs and healthy nutrition education may offer a more comprehensive approach than just adding incentives to the current SNAP program to improve diet and reduce nutrition-related disease among SNAP participants.

SNAP is an important federally-funded program as it helps reduce the prevalence of food insecurity faced by millions of financially challenged Americans. However, given the rising prevalence and healthcare costs of diet-related chronic diseases, (Finkelstein et al., 2009) providing opportunities to SNAP participants to use their SNAP benefits appropriately to improve their health and reduce risk of disease is important as well. We recommend the inclusion of a comprehensive set of strategies to be included in SNAP, including improving access to healthy foods such as fruits and vegetables, providing added monetary incentives or rebates for healthy food purchases, restricting allowable benefit purchases to mirror current USDA nutrition guidelines, and increasing nutrition and health advocacy and education for SNAP participants. Furthermore, additional research using robust study designs, such as randomized controlled trials, with state-of-the-art dietary and health assessment tools and longer-term follow up are needed to determine the impact of these interventions among the SNAP participants.

5. Limitations

Limitations include variability in study designs and quality of publications included in this review. Variability in study outcomes, and how they were defined and measured, made it challenging to compare the evidence available. Most of the studies had a small study population or were based in one area, therefore the findings could not be generalized to other areas. For example, even the SEBTC study which was the most widespread, the authors reported their study might not be

generalizable as the WIC sites were concentrated in the West and South where the percentage of Hispanic population is higher. In assessing the quality of the studies in Table 2 there are several areas of improvement in future studies including, using study arms that are similar, larger sample sizes, appropriate randomization methods, blinding of data collection staff, using reliable and standardized tools like Healthy Eating Index to measure diet quality and increasing the length of follow up. Future research warrants the use of studies with larger sample sizes in diverse populations to improve external validity of the findings. Perhaps demonstration studies using pragmatic trial designs with more stringent process evaluation measures, documenting intervention dosage, reach, fidelity may be warranted.

Studies that did not specify targeting SNAP participants were excluded. This likely led to the exclusion of studies that intervened upon low-income populations, many of whom may have included SNAP participants. However, the goal of this scoping review is to inform strategies and recommendations specifically for the SNAP program. These limitations notwithstanding, we believe this scoping review is a comprehensive summary of the literature assessing the impact of interventions specifically targeting outcomes among SNAP participants.

6. Conclusion

This study reviewed the interventions that targeted the SNAP population. Although financial incentive programs showed a modest improvement in fruit and vegetable intake, the impact on health would be limited. Adding restrictions on how the SNAP benefit is spent with incentives for fruit and vegetable could potentially direct the SNAP population to improve their diet quality, and thereby help them with weight management, reduce comorbidities and improve health related quality of life.

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