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ORIGINAL ARTICLE

Supporting Wellness at Pantries (SWAP): changes to inventory in six food pantries over one year

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Abstract

Background The aim of the Supporting Wellness at Pantries (SWAP) system is to rank, label, and organize food pantry items according to whether they should be consumed often (green), sometimes (yellow), or rarely (red), using a stoplight system in accordance with the 2015–2020 Dietary Guidelines for Americans. This study assessed the nutritional quality of inventory available at six food pantries before and after implementing SWAP. The hypothesis was that the intervention would encourage efforts to procure healthier foods.

Methods Six food pantries participated in the study. At baseline, the inventory was assessed over 4 weeks in the summer of 2016. The percentage of red, yellow, and green foods was calculated by food category. The intervention was implemented from October 2016 to June 2017. The follow-up inventory assessment occurred during 4 weeks in the summer of 2017. Multivariate regression analyses were performed to assess whether the nutritional quality of food pantry inventory (measured by SWAP rank) improved post-intervention, adjusting for time trends and food category fixed effects.

Results Results revealed that post-intervention, the average weekly pantry inventory contained 28.35 ($p = .037$) more pounds of green food in each food category. There were no significant changes in the pounds of yellow ($\beta = 13.77$, $p = .31$) or red ($\beta = -2.89$, $p = .78$) food available.

Conclusions One year post-intervention, the nutritional quality of food pantry inventories improved. These findings support continued structural changes to promote healthy food access to people experiencing food insecurity.

Keywords Food pantry · Food insecurity · Nutrition rating system · Community-engaged research · Behavioral economics strategies

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Introduction

"Food insecurity" describes the state of being without reliable access to sufficient nutritious food due to limited financial resources (Coleman-Jensen et al. 2014, 2015, 2018). In the United States, food banks started as grassroots organizations that offered free food to community members on a temporary, emergency basis (Campbell et al. 2015; Webb 2013). Since the early 1980s, the system has evolved into a sophisticated network including 200 food banks—large food storage and distribution centers that receive food from food suppliers—and 60,000 smaller agencies that distribute food directly to consumers (e.g., food pantries, shelters, soup kitchens) (Campbell et al. 2015; Feeding America 2020; Bazerghi et al. 2016; Campbell et al. 2013).

Despite the original vision of food banks as a temporary, emergency measure, many food-insecure households rely on food pantries as a regular source of groceries (Babic et al. 2015; Bhattarai et al. 2005). Food insecurity is associated with poor diet (Robaina & Martin 2013; Simmet et al. 2017a) and increased risk of diet-related chronic diseases such as type II diabetes and hypertension (Gregory 2017; Seligman et al. 2010; Seligman et al. 2009; Weinfield et al. 2014). Thus, there has been increased attention toward improving the nutritional quality of food in the food banking system (Campbell et al. 2013; Campbell et al. 2015; Seligman et al. 2015; Webb 2013; Shimada et al. 2013; Stroebele-Benschop et al. 2019).

Early research on the nutritional quality of food offered in pantries focused on macronutrients, micronutrients, and food categories available in pre-packed food bags (Akobundu et al. 2004; Simmet et al. 2017b; Greger et al. 2002); however, more recent work has assessed the overall nutritional quality of pantry inventory (Simmet et al. 2017a). Nanney and colleagues used invoices from two large Minnesota food banks to generate Healthy Eating Index 2010 (HEI-2010) scores of overall nutritional quality (range 0–100) for about 300 pantries (Nanney et al. 2016). Subsequently, this research team compared HEI-2005 to HEI-2010 scores in the same pantries (Grannon et al. 2017). Regardless of HEI measure, the nutritional quality of pantry inventory fell in the "needs improvement" range with HEI-2005 and HEI-2010 scores of 69.3 and 62.6, respectively (Grannon et al. 2017). Notably, these findings reflect the overall nutritional quality of products that pantries order from the food bank, but not inventory obtained from other sources (e.g., grocery stores, donations).

Building upon this earlier work to account for pantries' food sourcing beyond food banks, recent studies have conducted inventory audits and found continued inadequacies in the nutritional quality of foods available to clients within pantries (Bryan et al., 2019; Agyemang et al. 2018; Caspi et al. 2019). For instance, consistent with earlier Minnesota studies, baseline HEI-2010 scores from a recent evaluation of a behavioral economics intervention in two client-choice pantries (where clients "shop" for their food items rather than receive prepacked boxes) were 65 and 61 (Caspi et al. 2019; Remley et al. 2010; Remley et al. 2013). This indicates that before the intervention, the nutritional quality of the pantry inventory fell in the "needs improvement" category. Aside from studies using HEI-scores, Bryan and colleagues computed NuVal scores (range 1–100; higher score indicates higher nutritional quality) via inventory audits of urban pantries in New York (Bryan et al., 2019). Mean NuVal scores were mid-range, but higher for client-choice pantries (69.3 vs. 57.4). In another recent study involving inventory audits, Agyemang et al. (2018) measured the nutritional quality of inventory at a Milwaukee food pantry compared to the 2010 Dietary Guidelines for Americans. Results showed that only 11% of the inventory was ranked as "high-density" for nutrients (Agyemang et al. 2018). Taken together, the literature to date on the overall nutritional quality of items available in pantries is scant and geographically focused on pantries located in the Midwest region of the US. Additional assessments of inventory for food pantries outside the Midwest and that holistically capture the nutritional quality of items on food pantry shelves are essential to designing effective interventions that alleviate diet-related health inequities among clients.

To help shoppers identify healthy options, nutrition ranking information has been introduced to consumers with systems such as NuVal and Guiding Stars in retail food environments (Cawley et al. 2015; Sutherland et al. 2010). Beyond retail settings, nutrition ranking systems and other behavioral economics strategies are increasingly acknowledged as viable options for improving the within-pantry food environment (Caspi et al. 2019; Simmet et al. 2019; Shanks 2017). For example, Caspi et al. tested a behavioral economics intervention in two Minnesota food pantries that set stocking standards for healthy foods and manipulated shelving to make nutritious items more appealing. Encouragingly, the inventory in the pantries received higher HEI-2010 scores post-intervention, suggesting that the intervention increased the nutritional quality of the inventory (Caspi et al. 2019).

Supporting Wellness at Pantries (SWAP)

Supporting Wellness at Pantries (SWAP) is a nutrition ranking, labeling, and pantry organization system that categorizes food pantry inventory based on 2015–2020 Dietary Guidelines for Americans for the three nutrients most associated with chronic disease risk: saturated fat, sodium, and sugar (Dietary Guidelines Advisory Committee 2015). Based on recommended levels for these three nutrients and the MyPlate Daily Checklist for recommended servings, SWAP labels items within ten distinct food categories as green, yellow, or red items (i.e., low, moderate, and high in saturated fat, salt, or sugar, respectively) (Martin et al. 2018). Food pantries using SWAP are encouraged to place green items at eye level

and at the front of the food pantry to "nudge" customers to choose healthy items.

Utilizing a community-engaged research approach, SWAP was developed with input from food pantry staff (Cooksey-Stowers et al. 2018a) and clients (Cooksey-Stowers et al. 2018b). This was a critical step for bringing systemic nutrition guidance to the food pantry-level, particularly for client-choice pantries. A key objective of the SWAP system was to provide simple, transparent information to encourage food pantry staff to procure more nutritious food items for their agencies and simple nutrition education for clients to select healthy foods among the options available. To achieve this, SWAP implements stoplight signage (highlighting foods to choose often [green], sometimes [yellow], or rarely [red]) to provide information about the nutritional quality of foods available in the pantry (via signage) and to encourage healthy food procurement (via feedback sessions and staff trainings). Importantly, SWAP places a heavy emphasis on manipulating the placement of food on shelves to encourage the supply, visibility, and selection of green or yellow food items in pantries. Details regarding cut points that delineate SWAP categories and the community-engaged research methods used to design the intervention are recently published (Martin et al. 2018).

The goal of the present study was to measure the overall nutritional quality of food items in client-choice pantries using SWAP nutrition standards and evaluate the impact of introducing the SWAP system on the nutritional quality of food items post-implementation. The research group hypothesized that the process of implementing the SWAP system would prompt food pantry directors to procure healthier items over time.

Methods

Sample description

We worked with the two food banks in the state to recruit a purposive sample of six food pantries (three from each food bank service area) to participate in the study. These pantries were client-choice and had directors who had expressed interest in nutrition. All six pantries approached agreed to participate. The pantries varied in size, hours of operation, and staffing. Additional information about the pantries is presented in Table 1.

Study design

This feasibility study used a pre–post design to assess changes in inventory post-SWAP implementation. Baseline inventory assessments were conducted once a week for 4 weeks at each pantry in July and August 2016. At each site visit, team members recorded information about every food item in the pantry, including food category (e.g., fruits, vegetables, grains), brand

Table 1 Pantry Profiles

Pantry	Hours of operation	Staff	Frequency of permitted client visits	Storage	% of food sourced from the food bank	% of food sourced from store pickup	% of food sourced from purchasing	% of food sourced from donations/food drives	Avg no. of people served monthly	Avg meals of food distributed monthly in pounds	Service area
1	1 day/week 5:00 pm – 6:30 pm	1 paid	1x/week	Shelves & refrigerators	70%	15%	5%	10%	662	4589	A
2	4 days/week 9:00 am – 5:00 pm	2 paid	1x/month	Shelves & refrigerators	43%	0%	39%	18%	500	1500	B
3	3 days/week 10:00 am – 1:00 pm	1 paid >10 volunteers	1x/month	Shelves & refrigerators	30%	49%	20%	1%	1595	17,548	A
4	1 day/week 8:30 am – 10:30 am	0 paid	1x/month	Shelves & refrigerators	90%	0%	7%	3%	520	12,000	B
5	1 day/week 9:00 am – 10:30 am	3 paid and over 30 volunteers annually >10 volunteers	1x/week	Shelves	80%	0%	20%	0%	712	9752	A
6	3 days/week 9:00 am – 3:00 pm & 2 week nights & 1 Saturday/month	3 paid and over 130 volunteers annually >130 volunteers >100 volunteers	1x/month	Shelves & refrigerators	37%	0%	36%	27%	1000	112,000	B

name, package type (e.g., can, fresh), and weight. Saturated fat (g), sugar (g), and sodium (mg) were recorded for all packaged items. The number of units (e.g., box, can, pounds) of each food was counted and logged. Data collection occurred on a day the pantries received major deliveries to minimize the impact of client selection and inventory turnover.

The SWAP intervention employed community-engaged research methods and was implemented for 8 months (i.e., October 2016 to June 2017). The first phase of the intervention involved feedback sessions with food pantry directors and staff members to review assessments of their inventory at baseline. Next, the research team reorganized each pantry with posters and other reference materials describing the SWAP system in both English and Spanish. In response to client input, these materials included low sugar and low sodium labels. Lastly, food pantry staff and volunteers were trained on how to rank and categorize food using the SWAP system. For all six pantries, follow-up data collection occurred once a week for 4 weeks from early June to early July 2017, 1 year after baseline data collection. This study received approval from the University of Connecticut Institutional Review Board.

Community engagement with pantries: intervention components

Feedback sessions with food pantry directors

Feedback sessions were conducted in October and November 2016 with the directors of the six food pantries to share baseline inventory results. An intervention plan was developed for piloting the SWAP system based on input from the pantry staff and volunteers. Despite initial concerns that their inventories would score as poor nutritional quality and be "all red," most directors were pleasantly surprised to see the distribution of green, yellow, and red items among their food choices. Members of the research team and food pantry leaders additionally discussed best practices for improving the nutritional quality of pantry inventory by food group plus ways to reconfigure the pantry layout to promote "green" foods.

Training staff and volunteers

Initial and refresher trainings were conducted in December 2016 through March 2017. Food pantry staff and volunteers were provided with reference guides for categorizing foods according to SWAP and were trained by members of the research team on how to sort and shelve food items using the SWAP system. These trainings were central to the intervention because the staff and volunteers are responsible for food procurement and shelving newly purchased or donated foods.

Pantry reorganizations with signage, shelf tags, and flip cards

The research team worked with directors to identify days for pantry shelves to be reorganized according to the SWAP system. Pantries were reshelved such that green items were placed at eye level, yellow below, and red at the bottom. After food items and shelves were reorganized, signage and shelf tags were added around the pantry. Green, yellow, and red shelf tags were labeled "Choose often," "Choose sometimes," and "Choose rarely," respectively. Two food pantries use a table approach where food is displayed on tables rather than shelves for distribution to clients. At these pantries, the SWAP tags were displayed on the table in front of the food items to designate by color. Wall posters and one-page flyers were developed to describe SWAP and provide simple messages of the stoplight system (e.g. green: choose often).

Measures

Pounds of food available

A variable reflecting the total pounds of food available in each food category in each nutritional rank in each week in each pantry.

Post-SWAP intervention

A binary variable indicating baseline (0) or follow-up (1) was created.

Food category

Each food item was classified into one of the following ten groups: 1) fruits, 2) vegetables, 3) dairy, 4) grains, 5) protein (animal-based), 6) protein (plant-based), 7) beverages, 8) desserts and snacks, 9) combination foods or meals, and 10) condiments.

SWAP rank

Each food item was classified as green, yellow or red based on SWAP nutrition standards (Table 2).

Time trend

A variable indicating the week of the observation, ranging from 1 to 8 (1–4 before the intervention, 5–8 after the intervention).

Time since SWAP

A variable indicating the week since the intervention, 0 if before intervention and 1–4 after the intervention.

Table 2 SWAP Nutrition Standards by Food Category

Food group	Food item examples	Nutrient to limit	Green	Yellow	Red
Fruits	Fresh, frozen and canned fruit, 100% fruit juice	Saturated fat	≤ 1 g	≤ 1 g	≥ 1.5 g
		Sodium	≤ 32 mg	≤ 50 mg	≥51 mg
		Sugar	≤ 12 g	≤ 25 g	≥ 26 g
Vegetables	Fresh, frozen and canned vegetables	Saturated fat	≤ 1 g	≤ 1 g	≥ 1.5 g
		Sodium	≤ 140 mg	≤ 230 mg	≥231 mg
		Sugar	≤ 4 g	≤ 7 g	≥ 8 g
Grains[a]	Bread, pasta, rice, cereal, oatmeal, pancake mixes	Saturated fat	≤ 2 g	≤ 2 g	≥ 2.5 g
		Sodium	≤ 230 mg	≤ 400 mg	≥401 mg
		Sugar	≤ 6 g	≤ 12 g	≥ 13 g
Protein (animal)	Chicken, turkey, pork, beef, eggs, seafood	Saturated fat	≤ 2 g	≤ 5 g	≥ 5.5 g
		Sodium	≤ 200 mg	≤ 480 mg	≥481 mg
		Sugar	≤ 0 g	≤ 1 g	≥ 2 g
Protein (plant-based)	Beans, nuts, peanut butter	Saturated fat	≤ 2 g	≤ 5 g	≥ 5.5 g
		Sodium	≤ 200 mg	≤ 480 mg	≥481 mg
		Sugar	≤ 5 g	≤ 9 g	≥ 10 g
Dairy	Milk, yogurt, cheese, ice cream	Saturated fat	≤ 1.5 g	≤ 3 g	≥ 3.5 g
		Sodium	≤ 180 mg	≤ 200 mg	≥201 mg
		Sugar	≤ 12 g	≤ 22 g	≥ 23 g
Meals/combo foods	Soups, stews, pasta meals	Saturated fat	≤ 3 g	≤ 6.5 g	≥ 7 g
		Sodium	≤ 480 mg	≤ 600 mg	≥601 mg
		Sugar	≤ 7 g	≤ 10 g	≥ 11 g
Snacks/desserts[b]	Crackers, cookies, cakes, chips, granola bars, popcorn	Saturated fat	≤ 2 g	≤ 2 g	≥ 2.5 g
		Sodium	≤ 230 mg	≤ 400 mg	≥401 mg
		Sugar	≤ 6 g	≤ 12 g	≥ 13 g
Beverages	Water, tea, coffee, soda, juice drinks (not 100% juice)	Saturated fat	≤ 0 g	≤ 0 g	≥ 0 g
		Sodium	≤ 0 mg	≤ 160 mg	≥161 mg
		Sugar	≤ 0 g	≤ 11 g	≥ 12 g
Condiments	Jelly, mustard, ketchup, salad dressing, sauces, mayonnaise	Saturated fat	≤ 0 g	≤ 0.5 g	≥ 1 g
		Sodium	≤ 250 mg	≤ 350 mg	≥351 mg
		Sugar	≤ 2 g	≤ 7 g	≥ 8 g

[a] For all vegetables, the first ingredient must be "whole grain" to be green

[b] For all snacks and desserts, the first ingredient must be "whole grain" to be green

Data analysis

Statistical analyses were performed using STATA version 15.1. To compare differences in the overall nutritional quality of food pantry inventory across the six study sites at baseline and follow-up, descriptive statistics were computed for average pounds of food available from each food category in each nutritional rank per week. Multivariate regression analyses were performed to assess whether the nutritional quality of food pantry inventory (measured by SWAP rank) increased after implementing the SWAP intervention in the six pantries. The unit of analysis was *Food Category* (10 total) by *SWAP rank* (green, yellow, and red) by each pantry (six total) per week (1–8). The outcome variable is *Pounds of food available*. The predictor of interest is the dummy variable *Post-SWAP intervention*.

Regression models included food-group by pantry-level fixed effects (10×6 = 60 groups) so that the comparison is within each specific food group within each pantry. Separate regression analyses were run for each SWAP rank. As a robustness check, an additional analysis excluded several outliers in the outcome, added in additional controls for overall time trend *(Time_Trend)* and time trend after post-implementation *(Time_Since_SWAP)*, used robust standard errors and included log-transformed *Pounds of food available* as the outcome.

Results

Changes in overall food inventory

The average weekly pounds of food recorded in a pantry was 3295 pounds at baseline and 3687 pounds at follow-up. Average weekly pounds of vegetables available increased at follow-up (830 vs. 1127), as did pounds of grains (460 vs. 664), snacks/desserts (16 vs. 85), beverages (30 vs. 80), fruits (389 vs. 604), and condiments (99 vs. 117). In contrast, pounds of animal protein (340 vs. 256), plant-based protein (493 vs. 336), combination meals (427 vs. 217), and dairy (212 vs. 200) decreased. There was considerable variation in the amount of food in the inventory in each category across pantries, though vegetables consistently emerged as a top food category in terms of weight (see Fig. 1A for nutritional rankings breakdown of the average weight of each food category and how they changed pre- and post-intervention).

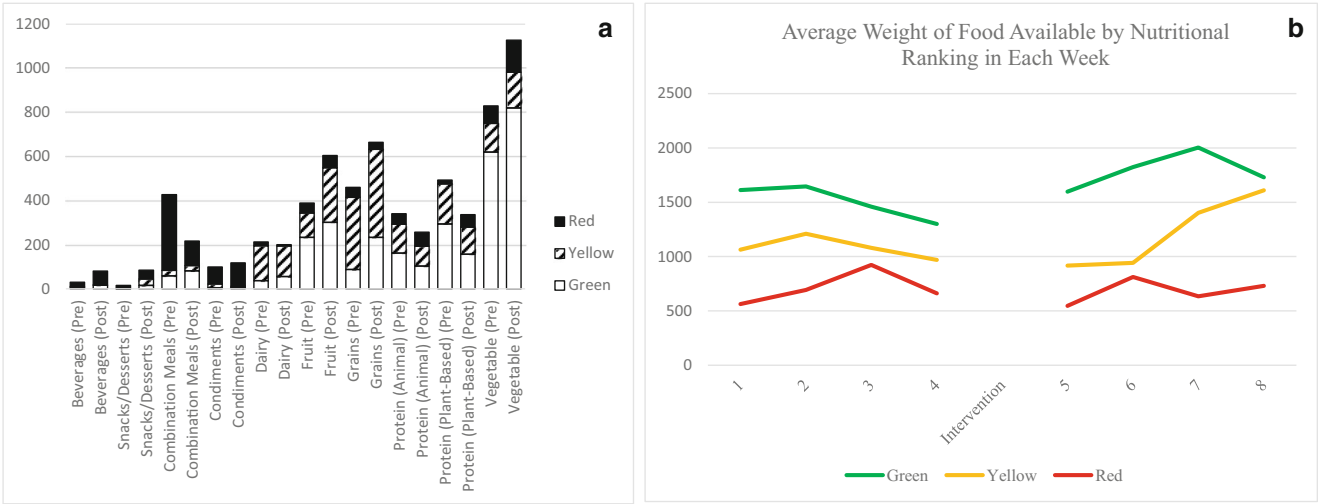

Fig. 1 Nutritional category breakdown by amount of food ordered and how they progress over time. (**a**) Nutritional category breakdown of average weekly weight (pounds) of food available by food category (pre- vs. post-intervention). (**b**) Average weekly pounds of food available by nutritional category across six pantries over time

Nutritional quality of food pantry inventory

Figure 1B plots how the average total pounds of food on the shelves for each pantry in each nutritional category change over time. As the figure shows, the amount of green and yellow food ordered post-intervention increased over time, while there was no visible change in the amount of red food in inventory. Relatedly, Table 3 indicates that the average weekly pounds of green food available by each pantry increased from 1505 pounds pre-intervention to 1788 pounds post-intervention, the average weekly pounds of yellow food available increased from 1081 pounds pre-intervention to 1218 pounds post-intervention, and the average weekly pounds of red food available decreased slightly from 710 pounds pre-intervention to 681 pounds post-intervention. In terms of the percentage of total food available, the average percentage of green food available across pantries increased from 45% pre-intervention to 49% post-intervention, the average percentage of yellow food available decreased slightly from 33% pre-intervention to 31% post-intervention, and the average percentage of red food available decreased from 22% pre-intervention to 19% post-intervention.

As shown in Table 4, results revealed that post-intervention, a pantry had 28.35 ($p = .037$) pounds more green food available in each food category in each week on average, while there were no significant changes in the amount of yellow ($\beta = 13.77$, $p = .31$) and red ($\beta = -2.89$, $p = .78$) food available post-intervention. Results were robust after running regression models that excluded several outliers (weekly presence of a specific food category larger than 600 pounds) (green $\beta = 28.23$, $p < .001$, yellow $\beta = 2.776$, $p = .75$, red $\beta = .924$, $p = .88$). See Table 4 for additional details. Additional robustness checks showed a generally consistent pattern after controlling for pre- and post-intervention time trends and including robust standard errors (green $\beta = 47.71$, $p = .02$, yellow $\beta = -14.12$, $p = .61$, red $\beta = -21.69$, $p = .38$), or using log-transformed weight (lbs.) as the outcome (green $\beta = .426$, $p = .0016$, yellow $\beta = .181$, $p = .21$, red $\beta = .432$, $p = .003$). See Appendix for additional details.

Table 3 Average weekly weight and proportion of food available in each nutritional category pre- and post-intervention by each pantry (standard errors in brackets)

	Before	After
Average weekly pounds of food available by each pantry		
Green	1504.9 (798.6)	1788.4 (585.4)
Yellow	1080.5 (459.7)	1218.2 (815.8)
Red	710.1 (416.7)	681.2 (294.3)
Average proportion of food available by each pantry		
Green	.5 (.2)	.56 (.1)
Yellow	.3 (.1)	.3 (.1)
Red	.2 (.1)	.2 (.1)

Discussion

Main findings of the study

Results provide insight into the overall nutritional quality of food items offered in six Connecticut food pantries and suggest that implementing the SWAP system in food pantries can significantly improve the nutritional quality of inventory. Yet, at baseline and follow-up, less than half of the overall food pantry inventory was classified as green.

Table 4 Fixed effects regression results

Variables	All data			Excluding outliers		
	Green	Yellow	Red	Green	Yellow	Red
Post-SWAP	28.4*	13.8	−2.9	28.2***	2.8	0.9
	(13.6)	(13.7)	(10.1)	(7.6)	(8.6)	(6.3)
Constant	150.5***	108.1***	71.0***	90.0***	93.1***	58.9***
	(9.6)	(9.7)	(7.1)	(5.3)	(6.1)	(4.5)
Observations	480	480	480	450	468	474
Within-group *R*-squared	0.010	0.002	0.000	0.034	0.000	0.000
Number of groups	60	60	60	59	60	60

What is already known on this topic

The main findings from this study are consistent with recent studies documenting that the overall nutritional quality of inventory "needs improvement" per the HEI and USDA Dietary Guidelines for Americans (Caspi et al. 2019; Grannon et al. 2017; Nanney et al. 2016; Agyemang et al. 2018), and supports the importance of efforts to improve the nutritional quality of food pantries. The changes observed over the year were mixed: fruit, vegetable, grain, and beverage inventory increased post-intervention, whereas proteins, dairy, and combination meals decreased. An explanation might be that the SWAP intervention prompted food pantry staff to procure (via orders and donation requests) more items within categories generally perceived as "healthy." For example, the increase in average pounds of grains can be attributed to a relatively high amount of green grains being available at follow-up. In line with this possibility, a recent national study found that food banks with nutrition ranking systems reported distributing more fruits and vegetables and less unhealthy snacks and beverages than food banks without a system (Feldman and Schwartz, 2018). Conversely, types of donations or foods available at the food bank may have shifted during this time. It is important to note that food pantry staff are often at the mercy of what food is available from their food bank.

What this study adds

The current study demonstrates the feasibility of implementing a nutrition ranking system in client-choice food pantries utilizing a community-engaged research approach. The input from pantry directors and staff in designing or translating intervention materials as well as during check-in points contributed substantially to the success of this pilot (Martin et al. 2018). The SWAP system was specifically designed for implementation in client choice pantries (vs. traditional pantries where clients received prepackaged items) because community leaders are increasingly opting out of prepackaging and promoting more socially acceptable pantry environments where individuals experiencing food insecurity can choose their own foods. Choice-based models are now considered important prerequisites for equitably implementing nutrition interventions in pantry settings (Simmet & Stroebele-Benschop 2019; Caspi et al. 2019).

Study limitations

Regarding study limitations, the research group recruited a small sample of food pantries in Connecticut through relationships with two of the authors. These pantries may be atypical because they were already interested in nutrition and willing to participate in a research study. Furthermore, due to the small sample size, we were not sufficiently powered to test the statistical significance of mean changes in average pounds by food category and SWAP rank. Also, because a control group was not included in the design of this study, causal inferences cannot be made.

Future work

Future work on the SWAP system should include a randomized controlled trial to assess the impact of the intervention on clients' food item choices, as well as donors and food banks' ordering systems. A recent systematic review emphasizes the relationship between foods offered in pantries and clients' diet quality (Simmet et al. 2017a). Based on their findings, the authors speculate that increased distribution of perishable foods would improve clients' diet quality and could potentially have a great impact on addressing malnutrition in this target population. Although the SWAP system was originally designed for food pantries, implementing a parallel system at the level of the food bank would potentially have greater reach and impact. If a food bank classifies its available foods as green, yellow, or red within its ordering system, pantries can use this information when selecting which items to order. While there is increasing recognition of the relationship between hunger and health, more work is needed to identify interventions that work to reduce food insecurity and health inequities, and to highlight best practices for resident and stakeholder engagement.

Implications for policy and practice

In summary, results indicate a relationship between implementing the SWAP stoplight nutrition rating system and improvements in the nutritional quality of the foods offered in six Connecticut food pantries. Drawing from previous evidence documenting the important relationship between food availability and food item selection (Caspi et al. 2019), this result suggests that improving pantry inventory can, in turn, improve the nutritional quality of foods that pantry clients take home for consumption. For clients that rely on pantries as an important food source during a typical month, improving the nutritional quality of inventory in these spaces might also translate to improvements in diet quality and diet-related health outcomes.

Beyond potential impacts on clients as consumers of charitable food, the findings from the current study are consistent with previous studies documenting the need for and importance of improving nutrition at food banks (Handforth et al. 2013; Seidel et al. 2015; Laquatra et al. 2014) and other levels of the food banking system (Campbell et al. 2013). This includes donors and food banks. If food banks and client-choice food pantries use the SWAP system, they can first obtain a clear understanding of their inventory to determine what percentage of their foods are green, yellow, and red. These organizations can then set goals for purchasing foods and, when working with donors, set goals to "swap" food items from red to yellow or yellow to green by choosing foods with less fat, sodium, and added sugar. The SWAP system additionally provides a tool to assist other on-site service providers, such as community health workers and social workers, in guiding clients toward health-promoting food choices. Systems changes within food pantries and food banks may have a large impact on food distributed to food pantry clients and, ultimately, on their diet and health.

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Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to disclose.

Ethical statement All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975 and its later amendments or comparable ethical standards. Informed consent was obtained from all participants included in the study.

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