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SMALL FOOD STORES ASSESSMENT IN LOW INCOME LOW ACCESS COMMUNITIES IN PROVIDENCE, RHODE ISLAND

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SMALL FOOD STORES ASSESSMENT IN LOW INCOME LOW ACCESS
COMMUNITIES IN PROVIDENCE, RHODE ISLAND

BY

YUYAO HUANG

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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ABSTRACT

Inventory requirements for authorized Supplemental Nutrition Assistance Program (SNAP) retailers have undergone several revisions to increase the availability of healthful foods. A proposed rule of 84 staple food items was not implemented due to concerns that stores would not withstand this expansion, resulting in a final rule requiring 36 items. This study used the Food Access Research Atlas data to characterize food provisions in 30 small retailers in areas with high and low proportion of SNAP and racial minority residents in Providence, RI. Stores were assessed with an audit instrument to tally variety, perishability and depth of stock of four staple food categories. Descriptive, ANOVA and chi square analyses were performed using SPSS. Across stores, 80% were compliant with the final rule, but 66.7% would need to expand their offerings to meet the proposed rule. Mean dairy variety was lowest among all categories ($p < 0.05$). Most stores met the perishability (92.3%) and depth of stock requirements (96.1%) under both rules. No difference was detected between areas with high and low proportion of SNAP and racial minority residents. Future expansion of requirements may increase healthful food availability without imposing undue burden on retailers in Providence, RI, excluding increased requirements for dairy variety.

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PREFACE

The basis for this research originally stemmed from a multi-site project conducted by the Illinois Prevention Research Centers Nutrition and Obesity Policy Research and Evaluation Network Collaborating Center. This paper was written in compliance with the University of Rhode Island graduate school Manuscript Thesis Format. The manuscript was prepared in accordance with the submission guidelines of the *International Journal of Environmental Research and Public Health*. The manuscript has been accepted for publication.

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MANUSCRIPT

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Staple food item availability among small retailers in Providence, RI

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ABSTRACT

Inventory requirements for authorized Supplemental Nutrition Assistance Program (SNAP) retailers have undergone several revisions to increase the availability of healthful foods. A proposed rule of 84 staple food items was not implemented due to concerns that stores would not withstand this expansion, resulting in a final rule requiring 36 items. This study used the Food Access Research Atlas data to characterize food provisions in 30 small retailers in areas with high and low proportion of SNAP and racial minority residents in Providence, RI. Stores were assessed with an audit instrument to tally variety, perishability and depth of stock of four staple food categories. Descriptive, ANOVA and chi square analyses were performed using SPSS. Across stores, 80% were compliant with the final rule, but 66.7% would need to expand their offerings to meet the proposed rule. Mean dairy variety was lowest among all categories ($p<0.05$). Most stores met the perishability (92.3%) and depth of stock requirements (96.1%) under both rules. No difference was detected between areas with high and low proportion of SNAP and racial minority residents. Future expansion of requirements may increase healthful food availability without imposing undue burden on retailers in Providence, RI, excluding increased requirements for dairy variety.

Keywords: food environment; food desert; SNAP; food assistance; community; local food culture; nutrition; small food stores; food insecurity

INTRODUCTION

In the United States, the prevalence of obesity among adults increased linearly between 1999-2000 and 2015-2016 (from 30.5% to 39.8%) [1]. In particular, obesity rates are disproportionally higher among Hispanic (47.0%) and non-Hispanic black (46.8%) adults as compared to other racial/ethnic groups [1]. Additionally, 21.2% of non-Hispanic black and 18.3% of Hispanic households live under the federal poverty level nationwide [2], which could exacerbate obesity rates given the proportional relationship between obesity and poverty rate [3]. Low socio-economic (SES) populations also have lower diet quality than high SES populations, the difference in Alternate Healthy Eating Index 2010 score between high-SES and low-SES groups increased substantially from 3.9 to 7.8 from 1999-2000 to 2009-2010, with non-Hispanic black adults having lowest diet quality among all ethnicities [4]. One contributor to their lower diet quality and subsequently higher obesity prevalence may be limited access to healthful foods [5–8]. According to a systematic review in 2010 [9], lower-income neighborhoods have fewer food outlets and are less likely to provide healthful food options to residents. While low-income households with automobiles often travel beyond the nearest stores to shop for foods [10], 2.3 million households in the U.S. do not have access to a vehicle or public transit and are estimated to live more than a mile from a supermarket [11]. Low-income and predominantly black and Hispanic neighborhoods have fewer supermarkets, and blacks, on average, travel a greater distance to reach their nearest supermarket [9]. Areas with limited food access, often termed food deserts, commonly exist in low-income neighborhoods with predominantly Black and Hispanic populations [9,12–14].

Residents in these underserved neighborhoods may benefit from increased selections of foods in the limited number of small retailers readily accessible to them.

One program intended to improve diet quality among those experiencing food insecurity is the United States Department of Agriculture (USDA) Supplemental Nutrition Assistance Program (SNAP), which subsidizes foods consumed at home, excluding alcohol, supplements and medicines and hot foods [15]. Recently, SNAP proposed expanding stores' inventory requirements in an effort to improve healthful food access for low-income populations, among whom 42 million participate in SNAP [16]. While SNAP receipt has reduced food insecurity [17,18], participation is associated with higher Body Mass Index, waist circumference, and metabolic risk factors [22], and SNAP participants have higher obesity rates than income-eligible and higher-income nonparticipants (40% versus 32% and 30% respectively) [19]. Additionally, while the evidence is not conclusive, the general consensus is that SNAP recipients have lower diet quality compared to higher-income nonparticipants and that most low-income populations, regardless of SNAP participation, fail to meet the Dietary Guidelines for Americans [20,21].

To encourage consumption of healthful foods among SNAP participants, public health efforts have promoted multiple interventions that aim to improve food purchasing behavior. One successful effort which was instrumental in informing the development of SNAP inventory requirements was expanding the provision of healthful foods in small food retailers [22–27]. Several attempts have been made to increase the variety and quantity of staple foods that SNAP-authorized stores are required to carry. According to USDA Food and Nutrition Service (FNS), staple foods

are defined as basic food items that make up a significant portion of an individual's diet and are usually prepared at home and consumed as a major component of a meal [47]. This broad definition allowed for certain food items that could be regarded as accessory foods to be counted towards staple foods, for example, cream cheese, cream and butter. The original rule from the Food Stamp Act of 1977 [28] required stores to carry a minimum of 3 varieties under each of 4 staple food categories: Fruits and Vegetables; Meat, Poultry, Fish; Breads and Cereals; Dairy, including at least 2 categories with perishable items (minimal stocking of 12 items). In February 2016, a new rule was proposed to increase the number of required staple items to 168 (a minimum of 7 varieties in 4 categories plus 6 depth of stock, i.e. the minimum number of units of every variety). However, depth of stock was reduced to 3 (84 items total, i.e. 4 categories x 7 varieties x 3 depth of stock) in December 2016 (hereafter referred to as the proposed rule) due to concerns that the expansion would impose substantial burden on small retailers [29]. One common concern was that the increase in the number of perishable items would result into spoilage, waste, and consequently cost to the retailers that is non-refundable by manufacturers; another concern being stocking logistics, for example, larger quantity of food items exceeding available shelf space [29]. Others expected that it would be difficult for retailers to carry the proposed seven varieties in the meat, poultry, fish category and the dairy category, and in response to this particular concern, the proposed rule had incorporated plant-based products as eligible varieties in these two categories [29]. However, the proposed rule was not implemented due to the Consolidated Appropriations Act in 2017 that required revision of definition of variety [30]. The final rule, which became effective in January

2018, reinstated the requirements of the original rule plus a minimum depth of stock of 3 (36 items total). (See Appendix 1 and footnotes of Table 3 for details.)

The idea that the proposed expansion of the rule is unacceptable stems from the concerns of increased administrative burden and profit loss for smaller retailers [31–34], but current knowledge about whether smaller retailers would adapt to the more stringent inventory requirements is limited. Therefore, it's important to evaluate how well they can meet the different requirements, to help determine if the concerns related to cost and burden are well founded. In addition, the perishability of foods within each category was also explored (i.e. whether a store carries a variety of food by having predominantly perishable items or shelf stable ones), as it has been reported that SNAP participants with limited access to perishable foods, particularly fruits and vegetables, have lower expenditure on those foods, which are part of a healthful dietary pattern [20,35].

Therefore, this study set out to characterize the food availability of 30 small retailers (approximately 73% of total small retailers) in five census tracts identified as food deserts in Providence, a city in the state of Rhode Island, aiming to help inform future inventory rules. This study stemmed from a multi-site project conducted by the Illinois Prevention Research Centers (PRC) Nutrition and Obesity Policy Research and Evaluation Network (NOPREN) Collaborating Center [36]. Specifically, the following questions were examined: 1) What proportion of the retailers met the different requirements, including variety, perishable categories (hereafter referred to as perishability), depth of stock and total stocking, in the original rule, final rule and proposed rule, respectively; 2) On average, how many varieties, varieties of perishable

items, depth of stock and total stocking did stores carry in each of the four staple food categories; 3) What proportion of the retailers carried perishable items within each category (though this was not a requirement in any of the rules); and for all three questions we compared whether there was a difference between areas with high and low proportions of SNAP and racial minority population.

MATERIALS AND METHODS

2.1. Overview:

A total of 30 stores were sampled from selected food deserts in Providence, RI. A five-page audit instrument was used to collect information at each store. To assess store inventory status under the original rule prior to the implementation of the current rule in January 2018, data collection took place in November and December 2017, skipping the week before Thanksgiving and the week of Thanksgiving due to potential inventory change for the holiday.

2.2. Sampling:

Because of the important role small retailers play in healthful food purchases in low-income neighborhoods, this study focused on assessing small food stores in selected food deserts in Providence, where the population is 34.3% non-Hispanic white, 42% Hispanic and 15.6% non-Hispanic black [37], with 26.9% of residents living under the poverty level, higher than the national average of 12.3% [2,37]. A food desert, as defined by USDA Economic Research Service (ERS) [38] is a census tract that is low-income (LI) and low-access (LA), with low-income residents and few large food stores. (See definitions of census tracts, LI and LA in Appendix 2 [38,39].) In order to locate food deserts, ERS developed the Food Access Research Atlas [40], an online database that assembles indicators of the food environment such as access and proximity to food stores at the census tract level. This tool has been employed in many previous studies investigating food retail access [41–43]. Tracts were selected by layering the Food Access Research Atlas LILA tracts on Google Maps and 2010 Census Tracts Shapefiles [44] and merging them with Food Access Research Atlas

2015 data [45] in Quantum Geographic Information System (QGIS) [46], an open source mapping tool. Tracts in Providence where at least 500 people or at least 33 percent of the population is greater than ½ mile from the nearest supermarket, supercenter, or large grocery store (hereafter referred to as LILA areas) were identified as food deserts for this study. Seventeen out of 39 census tracts in Providence, RI were identified as LILA areas, among which five tracts were further selected based on characteristics of interest shown in Table 1. Three tracts with a low proportion of non-Hispanic black and Hispanic, and a low proportion of housing units receiving SNAP benefits were selected (hereafter referred to as low SNAP and low racial minority tracts, mean=31.5% and 37.6% respectively). Two tracts with a high proportion of non-Hispanic black and Hispanic, and a high proportion of housing units receiving SNAP benefits were selected to serve as comparison (hereafter referred to as high SNAP and high racial minority tracts, mean=2.8% and 3.1% respectively).

Small non-chain grocery stores, convenience stores, dollar/discount stores, pharmacies/drug stores, and liquor stores, irrespective of SNAP authorization status, were included to obtain a comprehensive assessment (inclusion criteria). Given the focus of this study on small retailers, supermarkets and chain grocery stores were not assessed. Farmer's markets, butcher shops, and bakeries were also not assessed as they are not required to meet the inventory requirements to be SNAP authorized [47] (exclusion criteria). (Definitions of each type of store can also be found in Congressional Research Service (CRS) Report #R44650 [48].) Stores that met inclusion criteria were identified from each tract using Google Maps and the USDA SNAP retailer locator [49]. A total of approximately 41 small retailers were identified

among the five tracts. When a store was unavailable for auditing (i.e. did not exist or had permanently closed) or when store owners raised objections, a new store was added to the list of stores in order to obtain the desired sample size of 30 stores, with 15 stores in high SNAP and high racial minority tracts and 15 stores in low SNAP and low racial minority tracts. (Table 2, Figure 1)

2.3. Retail Audit:

Institutional Review Board exemption was obtained prior to store auditing. (ID: 1139592-1) All stores were accessed using an audit instrument developed by the Illinois PRC NOPREN Collaborating Center [36], which provides measures for store characteristics (e.g. interior and exterior features) and the availability of food items in the store (Appendix 3). The instrument has been tested for reliability in Illinois PRC research [36]. Auditors recorded information on up to 10 foods and/or beverage varieties under each of the four staple food categories, in the order from Fruits and Vegetables category to Meat, Poultry, Fish category to Breads and Cereals category and lastly to Dairy category. Under each category, food items were searched for from left to right in the sequence shown on the instrument page, giving priority to perishable items. Once 10 varieties were identified for a given category and at least one perishable item had been identified, that category was considered complete, and no additional data were collected. Accessory foods that are generally considered drinks, condiments, snacks or desserts were not counted per instructions. Food items that are in storage and not available on the shelves at the time of auditing were also not counted. Mixed dishes or multiple ingredient foods and beverages where the first ingredient was a staple food item were counted towards that accordant category,

unless the first ingredient was water, in which case they were classified by their second ingredient. For example, a frozen pizza would count toward the breads and cereals category if flour was the first ingredient, but would count toward the dairy category if the first ingredient was cheese [50]. (Refer to CRS Report #R44650 for detailed definitions of accessory foods and mixed dishes [48].) The depth of stock requirement under the first proposed rule of 6 was not evaluated as the number of items that could be recorded with the audit tool was limited to 1, 2, or 3 or more. Auditors completed a 2-hour live webinar provided by the Illinois PRC NOPREN Collaborating Center that instructed in detail the use of the audit tool. The webinar was taped for reference and any questions were answered either during the webinar or afterwards via email communication. A training manual was also provided for reference, with detailed definitions of store type, category, variety, perishability, depth of stock, accessory foods, mixed dishes and instructions on what should and should not be counted. Two trained auditors assessed the stores together to enhance data quality. Data collection was unannounced, but an explanatory letter written in English and Spanish was provided to store owners and staff when concerns were raised.

2.4. Analysis:

Based on the multi-site project proposed by the Illinois PRC NOPREN Collaborating Center, a sample size of 30 stores was selected. Because this study was primarily descriptive, a priori power was not calculated. Post-hoc power was computed to evaluate difference between high and low SNAP /high and low racial minority tracts, with large effect size of 0.5, alpha of 0.05 and degree of freedom of 1 resulting in a power of 0.8. The exposure variable for this analysis was stores located

in census tracts with a high (versus low) proportion of SNAP and racial minority households. Outcome variables included variety, perishability, depth of stock, and total stocking (See definitions of each in footnotes of Table 3).

2.5. Variety:

To determine the variety of foods that a store carried, the number of unique items in each of the 4 staple categories (i.e. fruits and vegetables, meat poultry and fish, breads and cereals, dairy) were assessed, and binary indicators were created to show whether a store met the variety requirement of at least 3 or 7 varieties.

2.6. Perishability:

To determine the variety of perishable items under each category, foods that are considered perishable (i.e. fresh/frozen/dips/mixed dishes in fruits and vegetables category; perishable 100% fruit juice or vegetable juice; fresh/frozen/mixed dishes in meat, poultry and fish category; fresh/ frozen/mixed dishes in breads and cereals category and fresh/frozen dairy) were counted. Binary indicators were created to indicate whether a store met the perishability requirement of having perishable item in at least 2 or 3 categories, if a store carried at least one perishable item under each category, and if a store carried at least 50% perishable items.

2.7. Depth of Stock:

Binary indicators were created to indicate whether a store met the depth of stock requirement of at least 3 units of items in all categories in the proposed rule and final rule.

2.8. Total Stocking:

Binary indicators were created to indicate if a store met the total stocking requirement of the different rules (n=12, 36 and 84 total items under the original, final and proposed rules, respectively).

All analyses were conducted using SPSS version 25 [51]. Descriptive statistics were used to determine the mean and/or proportion of retailers that met the different versions of requirements (i.e. variety, perishability, depth of stock) and the perishable items within each category. One-way ANOVA was performed to determine if mean variety differed across categories. Chi square tests were used to determine whether differences in the means and/or proportions in variety, perishability and total stocking were significant between high and low SNAP /high and low racial minority tracts.

RESULTS

3. Results

Among the 30 small retailers sampled, 80% were non-chain grocery stores and convenience stores; the remaining stores included 3.3% small discount store, 13.3% pharmacies and 3.3% liquor store. (Table 2) Of all stores, 86.7% were SNAP authorized; 6.7% of stores in high SNAP and high racial minority tracts and 6.7% of stores in low SNAP and low racial minority tracts were not SNAP authorized. (Table 2)

3.1. *Variety:*

Table 3 shows the proportion of stores that were able to meet the requirements in the original, proposed, and final rule, and also compares whether store inventory in high and low SNAP /high and low racial minority tracts differ with respect to meeting these requirements. Of all stores, 83.3% met the variety requirement in the original and final rule, i.e. 3 variety per category, but only 33.3% met the proposed rule, i.e. 7 varieties per category. Among SNAP authorized stores (n=26), 92.3% met the original and final rule, and 38.5% met the proposed rule. No significant difference in variety was detected between stores in high and low SNAP /high and low racial minority tracts; most stores in both high and low SNAP /high and low racial minority tracts met the original and final rules (86.7% and 80% respectively). Among SNAP authorized stores, 93.3% in both high and low SNAP /high and low racial minority tracts met the original and final rules. However, fewer met the variety requirements in the proposed rule (i.e. of all stores 26.7% in high SNAP and high racial minority tracts and 40% in low SNAP and low racial minority tracts; and among SNAP authorized stores, 30.8%

in high SNAP and high racial minority tracts and 46.2% in low SNAP and low racial minority tracts).

Table 4 shows mean of variety, variety of perishable items, depth of stock and total stocking in each category. The variety requirement was met the least often in the dairy category (83.3% and 40% that carried 3 and 7 varieties, respectively) compared to the other three categories (90% and 73.3-86.7 that carried 3 and 7 varieties, respectively). On average, stores carried a lower variety of dairy foods (mean= 5.40 ± 3.04) compared to the other three categories (mean= 7.80 ± 3.31 - 8.53 ± 3.16 , $p < 0.05$). (Table 4) Among SNAP authorized stores, 100%, 96.2% and 80.8% reached or exceeded 3, 7 and 10 varieties in the fruits and vegetables category; 100%, 84.6% and 50% in the meat poultry and fish category; 100%, 84.6% and 61.5% in the breads and cereal category; and 92.3%, 46.2% and 3.8% in the dairy category respectively. SNAP authorized stores carried more varieties of staple foods (mean= 33.15 ± 6.21) than stores that were not SNAP-authorized (mean= 6.25 ± 9.84 , $p = 0.01$).

3.2. Perishability

Perishability requirement: Of all stores, 83.3% met the perishability requirement (92.3% among SNAP authorized stores) in both the original and final rule, i.e. at least 2 categories with perishable items, and the proposed rule, i.e. at least 3 categories with perishable items (Table 3). No significant difference in meeting the perishability requirement was detected between stores in high and low SNAP /high and low racial minority tracts (i.e. of all stores, 80% in high SNAP and high racial minority tracts and 86.7% in low SNAP and low racial minority tracts; and among

SNAP authorized stores, 73.3% in high SNAP and high racial minority tracts and 86.7% in low SNAP and low racial minority tracts). (Table 3)

Perishable items within each category: There was a lower variety of perishable items in the breads and cereals category (mean= 2.07 ± 1.70) compared to other categories (mean= $4.67 \pm 2.58 \sim 6.20 \pm 4.09$, $p < 0.01$). (Table 4) Table 5 shows perishable items within each category. Of all stores, 76.7% had at least one variety of perishable item under all categories, but few carried more than half of perishable items.

3.3. Depth of Stock:

Depth of stock was not required in the original rule. Only one store did not meet the depth of stock requirement in the proposed and final rule (i.e. 3 or more items per variety) under the fruits and vegetables category and breads and cereals category. (Table 3) No significant difference in depth of stock was detected between stores in high and low SNAP /high and low racial minority tracts. (Table 3)

3.4. Total stocking:

Overall, 80% of all stores were compliant with the total stocking requirement (including categories, varieties, and depth of stock) in the original and final rule, but 66.7% would need to expand their offerings to meet the total stocking requirement in the proposed rule. (Table 3) Among SNAP-authorized stores, 88.5% were compliant with the total stocking requirement in the original and final rule, but 61.5% would need to expand their offerings to meet the total stocking requirement in the proposed rule. (Table 3) No difference was detected between stores in high and low SNAP /high and low racial minority tracts in meeting the total stocking requirement of the original or final rule (80% in both tracts), as well as that of the proposed rule (53.3% in high

SNAP and high racial minority tracts and 80% in low SNAP and low racial minority tracts). (Table 3)

DISCUSSION

This study set out to measure food availability among small retailers and whether disparities exist for minority populations in census tracts classified as food deserts in Providence, RI, with the aim of helping to inform future stocking rules for SNAP-authorized stores in LILA areas. Overall, most stores met all requirements including variety, perishability, and depth of stock in the original and final rules, and a higher number of stores would have also met all requirements in the proposed rule if the dairy variety requirement was excluded. No disparity was observed between high and low SNAP /high and low racial minority tracts in meeting the different requirements in all categories in the original, final and proposed rule or in perishability within categories. Detailed findings are discussed below.

4.1. Variety

Among SNAP authorized stores, 100% reached or exceeded 3 varieties and 96.2% reached or exceeded 7 varieties in the fruits and vegetables category, with 80.8% reaching or exceeding 10 varieties, indicating the feasibility of a more stringent requirement pertaining to fruits and vegetables than the current requirement of 3 varieties. Among SNAP authorized stores, 84.6% reached or exceeded 7 varieties in the meat poultry and fish category, suggesting the proposed rule towards meat poultry and fish varieties would not be extremely untenable. On average, the dairy category had a significantly lower number of varieties compared to the other three categories; fewer than half of the SNAP authorized stores carried 7 dairy varieties, confirming the concerns that meeting the proposed rule would be challenging for dairy category. Although the proposed rule expanded the definition of variety for dairy to having each

main ingredient (e.g. cow, goat, almond, rice, soy) by product type (e.g. milk, yogurt, cheese, butter, infant formula) considered a discrete variety, there was a lower variety of traditional dairy products to begin with compared to the other three categories.

Future policies may retain the current rule of 3 dairy varieties, but should ensure those are nutrient-dense options. Consistent with the Dietary Guidelines for Americans, cream cheese, cream, and butter should be considered ineligible varieties, as they are not counted toward dairy intake in the Dietary Guidelines for Americans [20].

Additional investigation to inform the definition of eligible varieties within dairy staples and to identify barriers to stocking dairy products is warranted.

4.2. Perishability

In this study, 92.3% of all retailers met the perishability requirements under all rules. Similarly, a study by Powell et al. which used the same audit tool and found that among 113 small retailers in Chicago found that 94.6% were compliant with the original and final rule and 93.8% met the proposed rule [52]. These findings, similar to an analysis from FNS that estimated 98% of small SNAP-authorized stores already stock sufficient perishable foods required in the proposed rule [29], suggest the concern of insufficient space for perishable foods was not well-founded. This study explored perishability within categories although it was not proposed in the revisions of SNAP inventory policy. Limited perishable varieties within categories could be related to several barriers. A report by Frazao et al. suggests that SNAP participants, when provided with additional SNAP dollars, fail to increase spending and consumption on fruits and vegetables [53]. Bodor et al. also pointed to the limited

shelf space in small retailers, which may require reducing certain non-perishable items in exchange for perishable foods, potentially leading to profit loss [31].

4.3. Depth of Stock

Most retailers in this study carried 3 or more units of each variety, which is in favor of future expansion of depth of stock requirement. Future studies could investigate the practicality of the depth of stock requirement of 6 under the first proposed rules, as it was not assessed in this study. The expansion of depth of stock could be an important strategy in improving dietary intake, informed by previous evidence. For example, a one unit increase in the availability of varieties in fruits and vegetables in corner stores was respectively associated with a 12% and 15% increase in customers' likelihood to purchase fruits and vegetables [25].

4.4. Total stocking

Most stores (80.0%) met the final rule that requires 36 staple food items, particularly SNAP-authorized stores (88.5%). Although only 38.5% of the SNAP-authorized stores met the proposed rule in all four categories (84 items), 73.1% met the proposed rule when the dairy category was excluded (data not shown in Tables). The finding that most retailers were able to meet a stricter rule before the final rule went into effect highlights the potential for small food stores to expand their offerings. This conclusion is consistent with findings by Powell et al. that 81.4% of stores met the variety requirements under the original and final rule, and 22.1% met the variety requirements under the proposed rule, with the least variety in the dairy category (i.e. only 23% of the stores carried at least 7 dairy varieties) [52].

Although no disparity was detected between high and low SNAP /high and low racial minority tracts in meeting the different requirements or in perishability within categories, descriptively, in stores with fewer than 10 breads and cereals varieties, 50% of stores in the low SNAP and low racial minority tracts carried >50% perishable varieties in breads and cereals category while none of the stores in high SNAP and high racial minority tracts did. It should be noted that non-Hispanic black and Hispanic populations were grouped as high SNAP and high racial minority tracts, potentially masking important differences, as some evidence suggests lower healthful food access and diet quality among non-Hispanic black populations compared to Hispanic populations [4,54,55].

The ability for small retailers to meet the proposed stricter requirement is important in improving food access. Along with various efforts that aim to improve diet quality [56,57], food access serves as a crucial determinant, in particular for residents in geographically isolated locations lacking healthful food outlets [9,58]. Nationally, approximately eighty percent of SNAP benefits were redeemed in supermarkets and superstores in 2016 [59]. However, evidence from regional studies indicates that SNAP participants with more severe food insecurity shop predominantly at smaller retailers [26], and small retailers have a large share of all SNAP redemptions in low-income neighborhoods, regardless of the presence of supermarkets [22]. Studies of corner stores, gas-marts, dollar stores, and pharmacies have associated increased stocking of healthful foods with increased purchases of healthful foods [24–26]. Lower availability of produce was associated with lower purchases of produce and higher purchases of sugar sweetened beverages in bodegas [27]. Therefore,

interventions in small retailers where choices are limited may be a promising solution to help improve the diet quality of low-income populations.

Previous research has identified important challenges that might hinder adequate healthful food provision among small retailers. For example, in a study by Ross et al., store owners identified barriers to expanding food offerings including low customer demand, high amounts of potential spoilage, and unfair pricing at the wholesaler [32]. Ross et al. suggest that if the proposed rule were to be considered again, the requirements could be revised proportionally to the size of the store and that administrative support and oversight from the USDA should be increased, as they are currently lacking. In particular, stores were largely unaware of the revisions in inventory requirements [32]. Nevertheless, a study by Haynes-Maslow et al. points out that the revision of the inventory rule for the Women, Infants, and Children Program in 2009 raised similar concerns, but the new rule has partly contributed to improved diet quality of its participants and few stores dropped out from unable to meet the inventory requirements [33].

To address challenges in healthful food provision, many innovative strategies have been developed and implemented successfully at the local level, with positive evaluations by stakeholders. These include The Food Trust's Healthy Corner Store Initiative, ChangeLab Solutions Healthy Small Food Retailer Certification Program, Shop Healthy NYC, Baltimore Healthy Stores, Wholesome Wave, and BrightSide [60–62]. Successful interventions have included incentives, improvement of store capacity of stocking and marketing healthful foods, provision of training and technical assistance for store owners, connecting store owners with local partners to encourage

healthful food sourcing, and produce delivery to stores [60–62]. Additionally, small retailers that struggle with sustaining adequate food varieties may consider cyclical inventory strategies to optimize flexibility of food provisions as seasons shift.

Some limitations of the present study must be noted. First, data collected for this study were cross-sectional and reflected food availability in stores only during the audit timeframe. No qualitative data were collected to reflect perceived food availability and feasibility of expansion from stores' perspectives, which might require further investigations. Additionally, pricing of food items was not assessed, but is a prioritized factor in food choice among low-income populations [63,64]. Finally, identification of food deserts based on census tract boundaries does not necessarily reflect food shopping behavior. Future studies may consider a multifactorial approach to identify food desert areas, for example, considering store proximity and walkability [65]. Though this study only measured food store environment and did not investigate its association with purchase behavior and dietary intake of customers, many previous studies have associated low provision of healthful foods with low diet quality, and improved provision with increased purchasing and intake [25,66,67].

Several strengths in this study should be highlighted as well. First, data were collected prior to implementation of the final rule, allowing for assessment of prior inventory status. Census tracts were carefully selected aiming for specific characteristics of interest, in order to reflect the demographic composition and healthful food access among small retailers in Providence. Broad sample coverage of 73% of the small retailers helped reduce risk for selection bias so that the findings were representative of the actual environment and increased the generalizability of the

findings to other low-income low-access communities as defined in this study, in Providence and cities with similar demographic makeup and SNAP participation rate. Additional studies in rural areas are needed to demonstrate if similar conclusions can be applied.

Further investigations among SNAP authorized small retailers are warranted to help inform the efficacy and feasibility of extension of perishability requirement within categories and if existing efforts at the local level could be expanded to a larger scale to support retailers in meeting the extension. Active communication between policy enforcement agencies and store owners are required to ensure sustainable operations while moving towards the improvement of food accessibility.

CONCLUSIONS

During November and December of 2018, most SNAP authorized stores (88.5%) sampled from selected LILA area in Providence, RI were already compliant with the final rule prior to its implementation and 73.1% already met the proposed minimum 7 varieties in three categories other than dairy. Future expansion of inventory requirements could potentially lead to increased healthful food availability without imposing undue burden on small retailers in Providence, RI, excluding increased requirements for dairy variety. If expansions of the requirements were to occur, stakeholders should draw on insights from existing initiatives to assist in successful implementation. Other initiatives looking to improve healthful food access should borrow current knowledge from SNAP and balance the competing interest among consumers, agricultural sectors and food distribution sectors [68]. Findings of this study advocate for future expansion of SNAP inventory requirements, which may be one important strategy in improving healthful food availability and help to facilitate improvement of diet quality of food purchases in small retailers in food deserts.

Table 1. Characteristics of 5 selected tracts in Providence, RI

	Tract #	Black or African American (%) beyond 1/2 mile from supermarket	Hispanic or Latino (%) beyond 1/2 mile from supermarket	Housing units receiving SNAP (%) beyond 1/2 mile from supermarket	Poverty rate (%)	Housing units without vehicle and beyond 1/2 mile from supermarket (%)
Low SNAP and low racial minority tracts	44007002300	0.91	1.56	1.61	26.3	1.43
	44007002900	1.43	2.00	2.17	27.7	1.67
	44007001300	1.47	9.24	5.36	29.5	1.67
High SNAP and high racial minority tracts	44007001600	8.88	50.42	30.42	27.8	6.6
	44007000700	33.86	32.99	44.7	50.2	30.8

Table 2. Number of stores by store type in high and low SNAP /high and low racial minority tracts (n=30).

	High ¹	Accept SNAP	Low ^{2*}	Accepts SNAP	Total
Non-chain grocery	9	8	3	3	12
Convenience store	4	3	8	7	12
Small Discount Store	0	0	1	1	1
Drug Store/Pharmacy	2	2	2	2	4
Liquor Store	0	0	1	0	1

* Includes 3 stores (2 non-chain grocery and 1 small discount store) that do not fall within the low SNAP and low racial minority tracts but are located at the boundary line of tract#44007002300. The stores were added to achieve more comprehensive sampling in low SNAP and low racial minority tracts.

¹. Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 31.5% and 37.6% respectively.

². Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 2.8% and 3.1% respectively.

Table 3. Proportion of stores meeting the different versions of variety, perishable categories, depth of stock and total stocking requirements (n=30)

	Original rule (%)				Proposed rule (%)				Final rule (%)			
	All stores	High ¹	Low ²	P value	All stores	High ¹	Low ²	P value	All stores	High ¹	Low ²	P value
Variety ³	83.3	86.7	80	1	33.3	26.7	40	0.7	83.3	86.7	80	1
Perishable categories ⁴	83.3	80	86.7	1	83.3	80	86.7	1	83.3	80	86.7	1
Depth of stock ⁵	100	100	100	---	96	93.3	100	1	96	93.3	100	1
Total stocking ⁶	80	80	80	---	33.3	26.7	40	0.7	80	80	80	---
	SNAP authorized stores (n=26)	High	Low	P value	SNAP authorized stores (n=26)	High	Low	P value	SNAP authorized stores (n=26)	High	Low	P value
Variety ³	92.3	92.3	92.3	---	38.5	30.8	46.2	0.688	92.3	92.3	92.3	---
Perishable categories ⁴	92.3	84.6	100	0.48	92.3	84.6	100	0.48	92.3	84.6	100	0.48
Depth of stock ⁵	100	100	---	---	96.1	92.3	100	1	96.1	92.3	100	1
Total stocking ⁶	88.5	84.6	92.3	1	38.5	30.8	46.2	0.688	88.5	84.6	92.3	1

^{1.} Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 31.5% and 37.6% respectively.

^{2.} Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 2.8% and 3.1% respectively.

³ “Variety” refers to different types of foods. For example, apples, cabbage and squash in the fruits and vegetables category would be variety of 3. The following does not meet the variety requirement: having different brands and sizes; having the same item but with varying ingredients (e.g., plain sausage and spicy sausage); or having the same item but offering different types of the item (e.g., Granny Smith and Red Delicious apples). Minimum requirements under original rule, proposed rule and final rule are 3, 7 and 3 respectively.

⁴ “Perishable categories” refers to categories with perishable items, i.e. items that are either frozen staple food items; or, fresh, un-refrigerated or refrigerated staple food items that will spoil or suffer significant deterioration in quality within 2 to 3 weeks. Minimum requirements under original rule, proposed rule and final rule are 2, 3 and 2 respectively.

⁵ “Depth of Stock” refers to the minimum number of units of every variety, i.e. if the depth of stock is 3, stores must have at least three units per variety. For example, if apples are going to be counted in the fruits and vegetables category, at least three apples and/or products with the apple as the first ingredient, such as applesauce or apple juice, need to be stocked in the store. Food items that are in storage and not available on the shelves at the time of auditing were not counted. Minimum requirements under original rule, proposed rule and final rule are 1, 3 and 3 respectively

⁶ “Total stocking” considers category, variety and depth of stock. For example, 7 varieties in each category with depth of stock of 3 results in total stocking of 84 (i.e. 4 categories x7 varieties x3 depth of stock). Minimum requirements under original rule, proposed rule and final rule are 12, 84 and 36 respectively.

Table 4. Mean of variety, variety of perishable items, depth of stock and total stocking in each category (n=30)

	Variety (mean ± SD)				Variety of perishable items (mean ± SD)				Depth of stock				Total stocking				
	All stores	High ¹	Low ²	P value	All stores	High ¹	Low ²	P value	All stores	High ¹	Low ²	P value	All stores	High ¹	Low ²	P value	
Fruits and Vegetables	8.53 ±3.16 ^a	8.60 ±3.18	8.46 ±3.25	0.910	6.20 ±4.09 ^c	6.20 ±4.14	6.20 ±4.18	---	3.94 ±0.31 ^e	3.88 ±0.44 ^e	4.00 ±0.00 ^e	0.326	33.62 ±12.63 ^f	33.9 ±13.08 ^f	33.33 ±12.62 ^f	0.904	
Meat Poultry and Fish	7.83 ±3.06 ^a	7.80 ±2.78	7.87 ±3.42	0.954	4.67 ±2.58 ^c	4.53 ±2.72	4.80 ±2.51	0.782	4.00 ±0.00 ^e	4.00 ±0.00 ^e	4.00 ±0.00 ^e	---	31.20 ±12.13 ^f	31.20 ±11.13 ^f	31.20 ±13.45 ^f	1.000	
Breads and Cereals	7.80 ±3.32 ^a	7.87 ±3.09	7.73 ±3.63	0.915	2.07 ±1.70 ^d	1.60 ±1.45	2.53 ±1.85	0.136	3.98 ±0.14 ^e	3.95 ±0.19 ^e	4.00 ±0.00 ^e	0.326	30.84 ±13.48 ^f	30.74 ±12.84 ^f	30.93 ±14.54 ^f	0.970	
Dairy	5.40 ±3.04 ^b	5.27 ±3.24	5.53 ±2.92	0.815	4.80 ±2.54 ^c	4.60 ±2.61	5.00 ±2.54	0.674	4.00 ±0.00 ^e	4.00 ±0.00 ^e	4.00 ±0.00 ^e	---	21.47 ±11.91 ^f	20.80 ±12.49 ^f	22.13 ±11.70 ^f	0.765	
All categories	29.57 ±11.39	29.53 ±10.82	29.60 ±12.32	0.988	17.73 ±8.49	16.93 ±8.89	18.53 ±8.29	0.614	3.96 ±0.18 ^e	3.93 ±0.26 ^e	4.00 ±0.00 ^e	0.326	117.12 ±45.66 ^f	116.65 ±44.06 ^f	117.60 ±48.75 ^f	0.956	
Variety (mean ± SD)				P value	Variety of perishable items (mean ± SD)				P value	Depth of stock			P value	Total stocking			P value
SNAP authorized stores (n=26)				0.010*	20.04±6.31				0.001 **	3.96±0.20 ^e			0.702	131.30±25.80 ^f			0.000 ***
Non-SNAP authorized stores (n=4)					2.75±4.27					4.00±0.00 ^e				25.00±39.38 ^f			

^{a-b} Means within a column with different superscripts differ ($p < 0.05$) Homogeneity of variances was not violated.

^{c-d} Means within a column with different superscripts differ. Homogeneity of variances was violated. Welch F (3, 62.079) = 15.772 ($p = 0.000$)

^e n=4 was assigned to variety of 3 or more

^f Calculated based on estimated and assigned variety and depth of stock for the purpose of comparison between tracts, not to taken literally.

^{1.} Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 31.5% and 37.6% respectively.

^{2.} Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 2.8% and 3.1% respectively

Table 5. Estimate of proportion of perishable items out of total items recorded in each category.

	>=1 perishable item				>50% perishable items							
	(in %, n=30)				All stores (in %, n=30)				Stores with <10 items in each category (in %)			
	All stores	High ¹	Low ²	P value	All stores	High ¹	Low ²	P value		High ¹	Low ²	P value
Fruits and Vegetables	90	86.7	93.3	1	73.3*	73.3*	73.3*	---	55.6 (n=5 /9 stores)	75	40	0.524
Meat Poultry and Fish	90	93.3	86.7	1	76.7*	66.7*	86.7*	0.39	70.6 (n=12/ 17 stores)	70	71.4	1
Breads and Cereals	80	73.3	86.7	0.651	16.7*	6.7*	26.7*	0.33	21.4 (n=3/ 14 stores)	0	50	0.055
Dairy	86.7	86.7	86.7	---	86.7*	86.7*	86.7*	1	86.2 (n=25/ 29 stores)	85.7	86.7	1
All categories	76.7	66.7	86.7	0.39	10*	0	20*	0.224	---	---	---	---

*Per instructions, a maximum of 10 varieties was recorded for each category during store auditing. Stores that were recorded to have met 10 varieties were likely to have carried more than 10 varieties, so the proportions of perishable items in those stores were estimates.

- ¹. Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 31.5% and 37.6% respectively.
- ². Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 2.8% and 3.1% respectively.

Figure 1. Map of Providence with 15 stores in high SNAP and high racial minority tracts¹ and 15 stores in low SNAP and low racial minority tracts²

¹. Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 31.5% and 37.6% respectively.

². Tracts where the mean of the proportion of Black and Hispanic residents and SNAP participating households are 2.8% and 3.1% respectively.

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LIST OF APPENDICES

Appendix 1. Inventory requirements for SNAP authorized retailers [48]

	Original rule	Proposed rules		Final rule
		Feb 2016	Dec 2016*	Jan 2018
Staple food categories	4	4	4	4
Varieties in each category	3	7	7	3
Minimum number of categories that must include perishable foods	2	3	3	2
Depth of stock for each variety	1 item of each variety	6 items of each variety	3 items of each variety	3 items of each variety
Minimum stocking total (considering categories, varieties, and depth of stock)	12 items	168 items	84 items	36 items

Appendix 2. Definition of census tract, low-income and low-access [38,39]

Census Tracts are small, relatively permanent statistical subdivisions of a county or equivalent entity that are updated by local participants prior to each decennial census as part of the Census Bureau's Participant Statistical Areas Program. The primary purpose of census tracts is to provide a stable set of geographic units for the presentation of statistical data. Census tracts generally have a population size between 1,200 and 8,000 people, with an optimum size of 4,000 people.

A low-income (LI) tract is defined as any tract that meets any one of the three criteria: 1) the poverty rate is 20% or greater; 2) median family income is $\leq 80\%$ of the state-wide median family income; 3) the tract is in a metropolitan area and has a median family income $\leq 80\%$ of the metropolitan area's median family income.

A low-access (LA) tract is defined as having a significant number or share of individuals far from a supermarket, supercenter, or large grocery store. Three measures of LA was provided in the Atlas:

1) At least 500 people or at least 33 percent of the population is greater than $\frac{1}{2}$ mile from the nearest supermarket, supercenter, or large grocery store for an urban area or greater than 10 miles for a rural area.

2) At least 500 people or at least 33 percent of the population is greater than 1 mile from the nearest supermarket, supercenter, or large grocery store for an urban area or greater than 10 miles for a rural area.

At least 500 people or at least 33 percent of the population is greater than 1 mile from the nearest supermarket, supercenter, or large grocery store for an urban area or greater than 20 miles for a rural area.

Appendix 3. Illinois PRC NOPREN Food Store SNAP Form

____-____-____

Illinois PRC NOPREN - FOOD STORE SNAP FORM - 2017					
BUSINESS NAME:			BUSINESS ID: ____-____-____		
ADDRESS:					
DATE ____-____-2017 STAFF 1 ____ STAFF 2 ____			DISPOSITION CODE		
START TIME ____:____ am/pm END TIME ____:____ am/pm			Temporarily not accessible		1
COMPLETION CODE			Not safe		2
COMPLETED		01	Asked to leave / Observation not allowed by staff		3
PARTIALLY COMPLETED – CODE DISPOSITION		02	Does not meet study criteria – DESCRIBE IN NOTES		4
NOT STARTED – CODE DISPOSITION		03	Other (SPECIFY):		5
NOT ELIGIBLE – CODE DISPOSITION		96			
Notes:			Notes:		
A. GENERAL AND CHECK-OUT					
A1. Type of Store			Interior Store Features		NO YES
Non-chain Grocery		1	A9. Is there a security mirror/camera/security guard?		0 1
Convenience Store (7-11, White Hen)		2	A10. Is there plexiglass/divider at the register?		0 1
Small Discount Store (Dollar General, Dollar Tree)		3	A11. Is 50% or more of the store's inventory beer, wine, and/or liquor?		0 1
Drug Store/Pharmacy (CVS, Walgreens)		4	A12. Does the store sell any tobacco products?		0 1
Liquor Store		5			
Other (SPECIFY):		6			
A2. Number of cash registers (IF 10+, CODE 10)			Exterior Store Features		NO YES
A3. Does the store accept EBT/SNAP?		NO YES	A13. Does the store have parking on-site?		0 1
A4. Does the store accept WIC?		NO YES	A14. Does the store sell gasoline?		0 1
A5. Does the store have a...?		NO YES	A15. Is garbage outside store entrance?		0 1
a. Bank		0 1	A16. Is graffiti on the store exterior?		0 1
b. Pharmacy		0 1	A17. Are bars on windows/door?		0 1
c. Butcher or fresh meat service counter		0 1			
d. Deli counter		0 1			
e. Bakery		0 1			
A6. Is there fresh meat available?		NO YES			
A7. Is there fast food or other hot ready-to-eat meals available?		NO YES			
A8. Does the store have any seating for food consumption?		NO YES			
		0 1

SNAP CHECKLIST (CIRCLE THE NUMBER OF UNITS AVAILABLE IF THE VARIETY IS PRESENT)									
STAPLE FOOD GROUP 1: FRUITS & VEGETABLES									
FRUITS	N	Perishable ☐		Shelf/Perishable ☐		Shelf Stable			
Apple		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Banana		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Dried
Blueberry		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Cantaloupe		1 2 3 +	Fresh						1 2 3 + Canned/Preserves 1 2 3 + Dried
Cranberry		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Grape		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Grapefruit		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	
Lemon		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	
Lime		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	
Orange		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Peach		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Pear		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Pineapple		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Strawberry		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	100% Juice	☐	1 2 3 + Canned/Preserves 1 2 3 + Dried
Watermelon		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	
		1 2 3 +		1 2 3 +		1 2 3 +			1 2 3 + 1 2 3 +
		1 2 3 +		1 2 3 +		1 2 3 +			1 2 3 + 1 2 3 +
VEGETABLES		Perishable ☐		Shelf/Perishable ☐		Shelf Stable			
Avocado		1 2 3 +	Fresh	1 2 3 +	Dip/ Guacamole				
Basil		1 2 3 +	Fresh	1 2 3 +	Frozen				
Broccoli		1 2 3 +	Fresh	1 2 3 +	Frozen				
Cabbage		1 2 3 +	Fresh						1 2 3 + Canned/Jarred
Carrot		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	100% Juice	☐	1 2 3 + Canned/Jarred
Celery		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	1 2 3 + Canned/Jarred
Collard Greens		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred
Corn		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred
Cucumber/Pickles		1 2 3 +	Fresh						1 2 3 + Canned/Jarred
Green Beans		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred
Lettuce		1 2 3 +	Fresh						
Mint		1 2 3 +	Fresh						
Mushroom		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred 1 2 3 + Dried
Okra		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred
Olives		1 2 3 +	Fresh						1 2 3 + Canned/Jarred
Onion		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred
Peas		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred 1 2 3 + Dried
Pepper		1 2 3 +	Fresh						1 2 3 + Canned/Jarred
Potato		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Instant Potato 1 2 3 + Canned
Spinach		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred
Sweet Potato		1 2 3 +	Fresh	1 2 3 +	Frozen				1 2 3 + Canned/Jarred 1 2 3 + Dried
Thyme		1 2 3 +	Fresh						
Tomato		1 2 3 +	Fresh			1 2 3 +	100% Juice	☐	1 2 3 + Canned/Jarred 1 2 3 + Dried
		1 2 3 +		1 2 3 +		1 2 3 +			1 2 3 + 1 2 3 +
		1 2 3 +		1 2 3 +		1 2 3 +			1 2 3 + 1 2 3 +
		1 2 3 +		1 2 3 +		1 2 3 +			1 2 3 + 1 2 3 +

STAPLE FOOD GROUP 2: MEAT/POULTRY/FISH/PROTEIN											
MEAT	N	Perishable ☐						Shelf Stable			
Beef		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned	1 2 3 +	Jerky
Goat		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other				
Lamb/Mutton		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned		
Pork		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned	1 2 3 +	Jerky
Meat Analogue (Soy-based)		1 2 3 +	Tofu	1 2 3 +	Vegan Chicken						
Meat Analogue (Gluten-based)								1 2 3 +	Seitan		
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
POULTRY		Perishable ☐						Shelf Stable			
Chicken		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned	1 2 3 +	Jerky
Duck		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other				
Turkey		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned	1 2 3 +	Jerky
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
FISH		Perishable ☐						Shelf Stable			
Catfish		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned	1 2 3 +	Smoked
Clam		1 2 3 +	Fresh	1 2 3 +	Frozen			1 2 3 +	Canned	1 2 3 +	Smoked
Cod		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned		
Crab		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned		
Salmon		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned	1 2 3 +	Smoked
Sardines		1 2 3 +	Frozen					1 2 3 +	Canned		
Shrimp		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned		
Tilapia		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned		
Tuna		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal/Other	1 2 3 +	Canned		
Whiting Fish		1 2 3 +	Fresh	1 2 3 +	Frozen						
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
PROTEIN		Perishable ☐						Shelf Stable			
Eggs (regular)		1 2 3 +	Fresh	1 2 3 +	Liquid White			1 2 3 +	Canned/Jarred	1 2 3 +	Powdered
Eggs (other)		1 2 3 +	Fresh					1 2 3 +	Canned/Jarred	1 2 3 +	Powdered
Plant-based Protein (Beans)		1 2 3 +	Fresh	1 2 3 +	Frozen			1 2 3 +	Canned	1 2 3 +	Dried
Plant-based Protein (Peas/Lentils)											
		1 2 3 +	Fresh	1 2 3 +	Frozen			1 2 3 +	Canned	1 2 3 +	Dried
Plant-based Protein (Nuts/Seeds)											Butter/ Spread
		1 2 3 +	Fresh	1 2 3 +	Frozen			1 2 3 +	Dried	1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	

STAPLE FOOD GROUP 3: BREADS/CEREALS/OTHERS											
BREAD	N	1 2 3 +	White	1 2 3 +	100% Wheat	1 2 3 +	Wheat (Other)	1 2 3 +	Multigrain	1 2 3 +	Barley
		1 2 3 +	Corn	1 2 3 +	Millet	1 2 3 +	Oats	1 2 3 +	Quinoa	1 2 3 +	Rye
CEREALS/OTHERS		Perishable ☐						Shelf Stable			
Wheat								1 2 3 +	Flour		
Barley								1 2 3 +	Raw	1 2 3 +	Flour
Corn								1 2 3 +	Raw	1 2 3 +	Flour
Millet								1 2 3 +	Raw	1 2 3 +	Flour
Oats								1 2 3 +	Raw	1 2 3 +	Flour
Quinoa								1 2 3 +	Raw	1 2 3 +	Flour
Rye								1 2 3 +	Raw	1 2 3 +	Flour
Bagels		1 2 3 +	Fresh	1 2 3 +	Frozen						
Biscuit		1 2 3 +	Fresh	1 2 3 +	Frozen						
Bread Crumbs / Breeding								1 2 3 +	Shelf stable		
Buns/Rolls		1 2 3 +	Fresh	1 2 3 +	Frozen						
Croissant		1 2 3 +	Fresh	1 2 3 +	Frozen						
English Muffin		1 2 3 +	Fresh	1 2 3 +	Frozen						
Pita		1 2 3 +	Fresh								
Tortilla		1 2 3 +	Fresh	1 2 3 +	Frozen			1 2 3 +	Shelf stable		
Pizza Crust/Dough		1 2 3 +	Fresh	1 2 3 +	Frozen						
Cereal (Cold Breakfast)								1 2 3 +	Shelf stable		
Cereal (Hot Breakfast)								1 2 3 +	Shelf stable		
Cereal (Infant)								1 2 3 +	Shelf stable		
Pasta		1 2 3 +	Fresh	1 2 3 +	Frozen	1 2 3 +	Meal	1 2 3 +	Dried	1 2 3 +	Canned
Rice		1 2 3 +	Frozen	1 2 3 +	Meal			1 2 3 +	Raw		
Teff								1 2 3 +	Raw	1 2 3 +	Flour
Baking Mix								1 2 3 +	Shelf stable		
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	
		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +		1 2 3 +	

STAPLE FOOD GROUP 4: DAIRY/PROTEIN						
	N	Perishable ☐			Shelf Stable	
Milk (Cow, Perishable)		1 2 3 + Fresh				
Milk (Cow, Shelf-stable, Liquid)					1 2 3 + Shelf stable	
Milk (Cow, Shelf-stable, Powdered)					1 2 3 + Shelf stable	
Milk (Goat, Perishable)		1 2 3 + Fresh				
Milk (Almond-based)		1 2 3 + Fresh			1 2 3 + Shelf stable	
Milk (Rice-based)		1 2 3 + Fresh			1 2 3 + Shelf stable	
Milk (Soy-based)		1 2 3 + Fresh			1 2 3 + Shelf stable	
Yogurt (Cow)		1 2 3 + Fresh				
Yogurt (Almond-based)		1 2 3 + Fresh				
Yogurt (Soy-based)		1 2 3 + Fresh				
Cheese (Cow, Hard)		1 2 3 + Fresh			1 2 3 + Shelf stable	
Cheese (Cow, Soft)		1 2 3 + Fresh			1 2 3 + Shelf stable	
Cheese (Goat)		1 2 3 + Fresh				
Cheese Alternative (Almond-based)		1 2 3 + Fresh				
Cheese Alternative (Soy-based)		1 2 3 + Fresh				
Butter		1 2 3 + Fresh	1 2 3 + Frozen			
Butter Substitute		1 2 3 + Fresh	1 2 3 + Frozen			
Kefir (Cow, Perishable)		1 2 3 + Fresh				
Sour Cream		1 2 3 + Fresh				
Infant Formula (Cow Milk Based)					1 2 3 + Shelf stable	
Infant Formula (Soy Based)					1 2 3 + Shelf stable	
		1 2 3 +	1 2 3 +	1 2 3 +	1 2 3 +	1 2 3 +
		1 2 3 +	1 2 3 +	1 2 3 +	1 2 3 +	1 2 3 +
		1 2 3 +	1 2 3 +	1 2 3 +	1 2 3 +	1 2 3 +

Notes:

Appendix 4. Review of literature

I. Introduction

Food access is recognized as having a significant influence on individual diet quality, and therefore on population health and well-being [1,2]. Low income populations face difficulty accessing healthful foods, which may contribute to poor diet quality [3–5]. To improve diet quality for low income populations, the federal Food Stamp program changed its name in 2008 to the Supplemental Nutrition Assistance Program (SNAP) to reflect the goal of supplementing budgets for nutritious foods [6,7]. In keeping with this objective, the program proposed expanding the variety and quantity of staple foods that SNAP-authorized stores were required to carry [8]. However, stakeholders raised concerns about the feasibility of expanding the offerings, and as a result the proposed requirements were reduced [9,10]. The purpose of this narrative review of the literature is to investigate current knowledge on the disparity of food access and diet quality, as well as policies and interventions for addressing barriers to access and quality, in order to help outline future research directions. Specifically, we will examine 1) current understanding of the ways the food environment influences diet quality and health outcomes; 2) the SNAP program and the ways that it has been attempting to improve diet quality among low income households; and 3) gaps in our current understanding of SNAP inventory policies.

II. Background

With abundant evidence of food deserts, food swamps and obesogenic environment, the relationship between food environment, diet quality and health outcome has been explored extensively over the past two decades [1,11]. Based on the ecological framework [12], there are a variety of complex factors that interact at four levels of influence--individual factors, social environment, physical environment and macro-level environment--that together affect dietary decisions. Food environment, for example, is one important factor. A food environment characterized by heavily-marketed, readily-available, calorically-dense foods, is associated with a lower likelihood of meeting ideal nutritional status and an increased risk of chronic disease such as obesity [13]. On the other hand, neighborhoods with an abundance of food stores that carry healthful, high-quality, affordable foods may encourage the purchase of healthful foods and lead to improved eating patterns [14].

Disparities in food environments can lead to disparities in access to healthful foods and diet-related health consequences [1,2,15,16]. In a systematic review of 38 studies, diet quality was strongly associated with the availability of food stores [1]. Increased availability of supermarkets was associated with a lower prevalence of being overweight or hypertensive, whereas the opposite was true for convenience stores [17]. Higher accessibility of unhealthful foods and convenience stores was associated with a higher obesity rate and BMI scores [18,19]. A greater variety of fruits and vegetables was usually available in larger food stores and was associated with improved dietary intake of fruits and vegetables [20], which is important given the protective association of fruits and vegetables and burden of diseases [21,22].

However, in communities with limited geographical access to full-service supermarkets or where stores carry low-quality items, residents may find it difficult to obtain healthful foods [23]. Such areas, often referred to as food deserts and food swamps in the literature [11,24], commonly exist in neighborhoods with a high proportion of racial minority or low-income residents.

Researchers in general agree that racial minority and low-income populations are more likely to be exposed to suboptimal food environments [3–5]. Areas with high racial minority and low-income populations were found to attract more fast food restaurants, convenience stores, and smaller grocery stores [25]. A disparity in food environment is also apparent between urban and rural neighborhoods. Rural residents often lack transportation and travel greater distances for food shopping or have fewer food resources, e.g. access to gardens, compared to urban residents [26–28]. The lower availability of healthful foods in rural areas was also partly associated with lower demand [29]. Rural residents also reported a greater likelihood of experiencing food insecurity [28], which further contributes to the disparity in diet quality. Therefore, it's unsurprising to see a health disparity between rural and urban populations, which can be partly attributed to the disparity in diet quality [2]. Nonetheless, food deserts exist in urban areas [2]. According to the Economic Research Service's definition of food deserts, low access to large food stores exists in both urban and rural areas, but with different definitions: At least 500 people or at least 33 percent of the population greater than ½ mile or 1 mile from the nearest supermarket, supercenter, or large grocery store for an urban area or greater than 10 miles or 20 miles for a rural area [30].

III. Assessing food environment

Given the important relationships among food environment, diet quality and health outcomes, multiple strategies have been developed and utilized to evaluate the existing food environment. Food environment is a broad concept that comes with various definitions and geographic boundaries that are challenging to measure. A common categorization measures food environment by five dimensions: availability, accessibility, affordability, acceptability, and accommodation [1,31,32]. A Geographic Information System (GIS) is one tool which can be used to measure availability and accessibility [1,33]. Some common indicators of these measures include presence or concentration of food stores and proximity to the nearest food store [1,34]. These are often measured based on ZIP code or census tract, though this approach does not represent utilization of food stores accurately. Therefore, some studies use multifactorial approaches to better model the food environment, such as a combination of proximity to food stores and walkability [35,36].

The measurement of store availability and accessibility is pertinent but inadequate if not accompanied by consideration of food availability, accessibility and affordability within stores [37]. For low-income populations, factors such as food pricing and convenience are also relevant determinants of their food purchasing behavior [22,38], and presence of supermarkets alone doesn't always reflect healthier purchasing behavior [11]. Store audits such as the Nutrition Environment Measures Survey are commonly used to measure availability and affordability by onsite data collection [1,39]. Other studies collect qualitative information such as perceived availability and affordability, usually through surveys, questionnaires or interviews

[38,40]. Location and display stands are common measurements for in-store accessibility of food items [9]. Less frequently measured are acceptability and accommodation [1,27], through assessments of consumers' attitudes towards features of the food environment (e.g. demand, food preferences) and how well the food environment serves the needs of consumers (e.g. store opening hours, type of payments accepted, cultural relevance of food provisions, food quality) [31].

IV. Supplemental Nutrition Assistance Program (SNAP)

Many studies have used the methodologies discussed in the previous section to evaluate food environments, particularly in areas with a high proportion of residents who participate in SNAP. SNAP, inaugurated in 1939 as the Food Stamp program, is the largest federal food subsidy program [6]. SNAP participants receive electronic benefits that can be redeemed at food retailers to support the purchase of foods for home consumption [41]. Nationally, around 85 percent of the eligible low-income population participated in the program in 2016 [42]. The program currently serves 42 million people [43,44], with over 66 billion dollars in SNAP benefits redeemed annually, accounting for approximately 10% of expenditures on food consumed at home [45]. Over the years, SNAP has played a significant role in combating food insecurity, the financial inability to obtain sufficient food to sustain healthy living, among low-income populations [43,44]. Recently, the program has become more attentive to the diet quality of participants, which will be discussed in detail in this section.

1) Diet quality and health outcome

Although SNAP helps low-income participants purchase foods to meet their caloric needs, SNAP participation is positively associated with BMI, waist circumference, and metabolic risk factors [46]. NHANES data in 2007-2010 reported SNAP participants have higher obesity rates (40%) when compared to income-eligible (32%) and higher-income nonparticipants (30%) [5]. Findings are mixed on whether disparities in diet quality are associated with SNAP receipt, according to a systematic review of studies from 2004-2013 [4]. Several reports highlighted that although both

SNAP participants and similarly low-income nonparticipants are able to reach sufficient caloric intake, SNAP participants have slightly lower diet quality indicated by the Healthy Eating Index-2005 and modified Alternative Healthy Eating Index than low-income nonparticipants [5,47,48]. Data from 1999-2008 NHANES survey showed that SNAP participants consumed 39% fewer whole grains, 44% more 100% fruit juice, 56% more potatoes, and 46% more red meat, and, in women, 61% more sugar-sweetened beverages than income-eligible nonparticipants [47]. However, other researchers found SNAP and non-SNAP households had similar food expenditure patterns across food categories [5,49]. NHANES data from 2001-08 indicated SNAP recipients have similar dietary intake as their income-eligible non-participants, with differences in a few categories: higher consumption of whole fruit and lower consumption of dark green and orange vegetables, sodium and saturated fat [48]. Despite the discrepancy in findings on diet quality, HEI studies generally agree that all low-income populations, regardless of SNAP participation, fail to meet the Dietary Guidelines for Americans [4], which recommends consuming a variety of health promoting foods (i.e. fruits and vegetables, grains, low fat dairy, and protein foods) [50].

2) Existing interventions

To improve food purchasing behavior (e.g. align food purchases with the Dietary Guidelines) and, consequently, diet quality among SNAP participants, various interventions have been proposed, implemented and evaluated across disciplines. One proposal is to impose restrictions to limit the use of SNAP benefits in purchasing unhealthful items, such as sugar-sweetened beverages (SSBs), which in 2011

accounted for almost 10% of total food expenditures in SNAP households [51]. Some suggest levying a sales tax on SSBs or excluding them from the allowable items that can be purchased with SNAP benefits [52]. However, previous research based on national samples found that consumption of SSBs does not differ between SNAP participants and income-eligible nonparticipants [4]. Furthermore, because SNAP benefits do not cover all food expenditures of SNAP households, the effect on consumption change under restriction is uncertain since SNAP participants can still purchase SSBs with non-SNAP income [49].

On the other hand, researchers are promoting strategies to encourage healthful food purchases [53]. Some interventions aim to address the barrier of food affordability by providing targeted incentives and increasing SNAP benefits to help with food purchasing directly [4,54]. Others propose improving access to larger food stores by subsidizing travel cost for rural residents [55]. In addition to economic approaches, nutrition education has been promoted as a strategy to increase interest in and demand for healthful foods. A recent study found that higher-income households had higher preferences for healthful foods, and that the disparity in food preference between higher and lower-income population was associated with a disparity in nutrition knowledge [56]. Since 2016, calorie labeling has been one strategy for improved disclosure of nutrition information. However, evidence of its efficacy in improving diet outcome among low-income populations is insufficient, as a disparity in usage of calorie information was found between low-income and high-income populations [11]. In-store interventions such as marketing-mix and choice-architecture strategies may also potentially shape food decisions towards purchasing more

healthful products, although the degree of sustainability of these interventions from a retail perspective requires further research [57].

3) Improving food provision in small retailers

Another viable approach to encouraging consumption of healthful foods for SNAP participants is to improve the provision of healthful foods in small food retailers. While some evidence suggests that SNAP participants do have access to larger food stores —on average, SNAP-participating households travel 3.4 miles to their primary food store, when the average nearest food store is 2 miles from the household [58] —2.3 million households in the U.S. live more than a mile from a supermarket and do not have access to a vehicle or public transit [59]. Some studies in low-income urban communities have demonstrated an association between increased stocking of healthful foods in corner stores and increased purchases of those foods [60,61]. In a study in bodegas, lower availability of produce was associated with lower purchases of produce and higher purchases of SSB [62]. Another study in corner stores, gas-marts, dollar stores, and pharmacies suggests healthful food availability measures to be positively associated with healthful food purchases [63]. The efficacy of increasing healthy food availability in small retailers has helped move forward the development of SNAP inventory requirements.

4) SNAP inventory requirements

Prior to January 2018, SNAP authorized retailers were required to carry four staple food categories: fruits and vegetables; meat, poultry, fish; bread or cereal; and dairy [8]. Each category was required to have 3 varieties of foods, with 2 categories having perishable items, and no requirement for depth of stock. In February 2016, a

new rule was proposed to enhance the requirements to include 7 varieties, 3 categories having perishable items and depth of stock of 6. The new rule was partly due to an effort initiated by FNS in 2013 to enforce the intent of the Food and Nutrition Act of 2008 to permit low-income individuals to purchase more nutritious foods [64]. In response to this rule, various sectors including retail food businesses, government, education, hospitals and health care, nonprofit organizations, and private citizens submitted a total of 1283 comments to FNS [65]. The proposed rule was modified in December 2016 to lessen the depth of stock to 3. This modification was made based on the consideration that a stricter requirement on inventory would potentially be burdensome to smaller retailers, as suggested in many of the comments. This proposed rule also increased flexibility to meet the required number of varieties by, for example, including plant-based products as varieties for the meat, poultry and fish category and dairy category. However, the implementation of the proposed rule was prohibited by the Consolidated Appropriations Act in 2017 which required USDA to re-define “variety” before implementing the proposed rule. This re-definition aimed to further increase the number of items that qualify as eligible varieties, to allow retailers more flexibility in meeting the variety requirements. Therefore, the proposed rule was not implemented and was reduced into a final rule that went into effect in January 2018 [64]. This final rule added the requirement of depth of stock of 3 while keeping the requirements of categories, varieties and perishable items consistent with the original rule.

5) Barriers towards expansion

Qualitative studies of stores have identified several issues that would need to be addressed to ensure the sustainability of store business if inventory requirements were expanded. Store owners and managers in these studies commonly expressed concerns about spoilage, pricing, space and perceived customer demand [9,10,66]. They worried about low demand for healthful foods and low consumer expectations of food offerings in small retailers [10]. However, this perceived barrier may not be the case for other small retailers. In another study, customers of small retailers in low-income areas in New Orleans showed high demand for produce [9]. Depth of stock of 6 was also of concern for many retailers [10,65]. For example, a regional chain of convenience stores which claims around 550 SNAP participating stores claimed that their current stocking needs and inventory management systems would not guarantee a minimum of six units at all times [67]. In a content analysis of 303 comments on the proposed rule of 168 items, common themes in comments opposing the rule included: definition of the specific requirements, potential of stores' withdrawal of participation, cost versus benefit, effectiveness, space, spoilage, free market, infrastructure, equipment and supplies [65]. Additionally, many small retailers were concerned that they would be unable to compete with larger food stores due to lower food quality or higher price, leading to food waste and financial loss [9,10]. Similar concerns were identified by 32 rural corner store owners across six states [66].

Most discussions revolved around the initial proposed rule of 168 items, but few studies investigated the readiness of small retailers to implement the proposed rule of 84 items with depth of stock of 3. In a study of corner stores in Baltimore, most store owners believed that they would be able to carry the proposed rule of 84 items,

except for perishable meats due to short expiration dates and perceived low demand [10]. Researchers suggested that this high confidence in implementation of the requirements indicated the likelihood of high compliance [10]. Increased administrative effort demanded by, for example, the higher frequency of purchasing from wholesalers to increase stocking of perishable items, was also a complaint [10]. Lack of cooler, freezer and shelf space was another barrier identified by some stores [9,10]. However, FNS estimated that 98% of SNAP participating small food stores already met the perishability requirement and on average only needed to add 24 items to meet the proposed rule of 84 items, which would not have been too burdensome in terms of storage [67].

6) Research gap

As discussed in the previous section, the low acceptability of the proposed expansion of SNAP inventory requirement was related to concerns that expansion would lead to profit loss and increased administrative burden for smaller retailers [9,10,65–67]. However, objective evidence on whether smaller retailers can meet the more stringent requirements is still limited. Assessment of how well retailers can meet the proposed rule of 84 items is needed to determine whether the more stringent requirements are feasible. In addition, given the numerous ways the requirements are met, it's worth evaluating whether stores are barely meeting or far exceeding the minimum number of varieties required under each category. The differences in types of foods within each variety could also be assessed (i.e. whether the items are predominantly perishable or shelf stable.)

Some other research directions that may be valuable should be noted as well. First, future studies may increase focus on food availability in rural communities, as a recent review of literature highlights the lack of rural-based food environment studies [68]. Additional investigation of acceptability and accommodation would also be helpful to identify potential barriers to improving food environments, given the lack of evidence at this time. Although expansion of proposed requirements may improve healthful food availability, more studies are needed to help determine its impact on operations from retailers' perspective and to inform practical strategies in addressing the difficulties. Lastly, as no disclosed information on the USDA's verification process of stores' compliance with the requirements is available [10], future investigations and evaluations are warranted.

V. Conclusion

Though interventions across multiple levels are necessary, enhancing SNAP requirements offers one promising strategy for improving food availability in small retailers. The purpose of this cross-sectional study is to measure food access among small retailers and to assess whether disparities exist for minority populations in food desert areas in Providence, RI, to help inform future rulemaking on provisioning in areas with limited access to healthful foods. Findings of this study will provide insights on future policies on food stocking in small food stores in underserved areas.

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