Assessing the Sodium Content of Foods in the Emergency Food System

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Abstract

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Background:

The emergency food system is an increasingly important source of food for food insecure households. Meanwhile, there is growing concern among food banks, food bank clients, and public health officials in regard to the quality of foods offered in food banks and whether they support the dietary needs of low-income populations. As agencies begin to implement interventions to improve the healthfulness of food bank offerings by targeting specific nutrients of concern, such as added sugar or sodium, a method of evaluation is required to properly assess the impact of these strategies. However, previous efforts to characterize the overall nutrition profile of foods distributed by the emergency food system have not focused specifically on nutrients of concern, thereby limiting the ability of food bank directors and policymakers to evaluate implemented actions.

Objective:

The purpose of this project was to develop and pilot test a methodology to assess the sodium content of food bank offerings. This project was driven by the need to facilitate baseline and ongoing data collection to assess the impacts of a CDC sodium reduction intervention in the emergency food system.

Methods:

The data collection team visited several food banks in King County, Washington in order to explore the barriers and opportunities for a methodology that could be used to capture the amount of sodium in food bank offerings. This methodology was pilot tested at the Des Moines Area Food Bank in King County, WA on January, 13, 2017. The food bank organizes similar food items into "bins" and specifies the number of items clients can take from each bin based on their household size. We assessed the mean sodium content in several bin categories per serving and 100kcals. In addition, we calculated the mean amount of sodium distributed per client visit from each bin. Finally, we assessed the smallest change in sodium (mg) needed to detect a difference from mean sodium per serving at follow-up visits by calculating the minimum detectable effect size.

Results:

The information for 306 unique items (n=1,395 total) were recorded and analyzed. Fresh prepared meals (e.g. individually packaged sandwiches, salads, etc.) had the highest mean sodium per serving, followed by boxed meals, canned soup/beans, tomato products, and pastry. There was little overlap in the bin categories with highest mean sodium per 100kcals with tomato products being the highest, followed by mixed canned vegetables, canned soup/beans, canned meats, and

boxed meals. The standard deviation of both mean sodium per serving and mean sodium per 100kcals indicates a considerable variation in the sodium content of inventoried items in the majority of bin categories. The mean daily sodium contribution from analyzed bin categories was estimated to be 2630mg for a small household, 1937mg for a medium household, and 1937mg for a large household. The percent change in mean sodium per serving needed to obtain a meaningful difference at follow-up ranged from 5-70.7% for bin categories. However, for the top five bin categories with highest mean sodium per serving (fresh prepared meals, boxed meals, canned soup/beans, tomato products, and pastry), 22.3% was the largest percent change needed.

Conclusion:

Prior efforts to reduce sodium in a variety of settings achieved reductions of 20-30%.[7] This evidence, combined with our results for the required percent change in mean sodium per serving, suggests that it is feasible to implement strategies with a measurable impact in the food bank setting, particularly by focusing on the bin categories with highest mean sodium per serving. Overall, this study contributes novel data on the sodium content of food bank offerings as well as perspectives on the feasibility of data collection in this venue. However, the methodology and pilot test that were developed and conducted in this study have some potential limitations in regard to generalizability. Data collection took place during a single shift, which prevented us from determining how food bank offerings may change across weeks or seasons. In addition, we excluded some bin categories due to feasibility reasons. Future evaluation efforts should work to strengthen this methodology by conducting repeat assessments to determine variation in food item distribution over days, weeks, months, and seasons. Furthermore, it would be useful to assess the differences in feasibility that may arise when applying this methodology in other food banks.

Introduction

Current levels of dietary sodium intake in the United States are alarming. The average American consumes over 3,400mg of sodium per day, which far exceeds the 2,300mg limit recommended in the *2015-2020 Dietary Guidelines for Americans*.[1] In large part, this is due to the overabundance of sodium in the food supply in the form of restaurant meals and processed foods.[2] The relationship between high sodium intake and increased risk of hypertension, coronary heart disease, and related cardiovascular disorders has been subject to debate, though several meta-analyses and cohort studies have provided strong evidence in support of this association in recent years.[3-5]

Furthermore, there is evidence to suggest that public health efforts to reduce sodium consumption are effective and have been associated with a decreased risk of cardiovascular-related conditions at a population level. One notable example was the United Kingdom's sodium reduction intervention which began in 2003 and involved establishing lower sodium targets in several food categories for the food industry, working with companies to reformulate their products to meet the targets, and launching an educational campaign regarding nutrition labels for consumers.[6] From 2003-2011, urinary sodium levels in the nationally-representative study cohort decreased by 15%, which was a statistically significant decrease.[6] In addition, results from the Health Survey for England in the same time period showed a significant decrease in both systolic and diastolic blood pressure, as well as stroke mortality (42% reduction) and ischemic heart disease mortality (40% reduction) after adjusting for age, sex, ethnicity, income, education, alcohol consumption, and BMI.[5] While a significant decrease in smoking prevalence and increase in fruit and vegetable consumption was also observed, it is unlikely that these factors alone accounted for the improvements in blood pressure, stroke mortality, and ischemic heart disease mortality among the study population given the evidence from prior interventions. For example, in the 1960s, a population-wide campaign in Japan decreased sodium intake by 4 g/day. A significant decrease in blood pressure and an 80% reduction in stroke mortality also occurred in the years following the campaign despite increases in fat intake, smoking, obesity, and alcohol consumption among the population.[6] As such, the extent to which sodium reduction contributed to England's health improvements in comparison to other factors is unclear, but it can be reasonably concluded that sodium reduction is an effective strategy for reducing the risk of cardiovascular-related conditions at the population level.

In the United States, the Centers for Disease Control and Prevention's (CDC) Sodium Reduction in Communities Program offers grant funding for community and population-based efforts aimed at reducing the sodium content of foods offered in several venues, such as schools, hospitals, government worksites, prisons, senior meal services, restaurants, and the emergency food system.[7] Many of these implemented strategies focus on food insecure populations, as food insecurity is associated with lower diet quality and cardiovascular health when compared to food secure populations.[8,9] Fourteen percent of the United States population was food insecure in 2014 and this number continues to rise, increasing demand on federal food assistance programs and the emergency food system, including food banks and food pantries.[10]

The number of individuals seeking aid from food pantries is now 1 in 7 people in the U.S. and while it was once typical for food insecure individuals to visit food pantries only on occasion, it has been demonstrated that many are increasingly visiting food pantries in a "chronic" pattern.[11] Prior research has also suggested that many offerings distributed by the emergency food system are energy-dense, processed foods high in sodium, added sugar, and trans-fat.[11] As such, public health professionals and food bank staff are turning an increasing focus on improving the availability of healthy foods in this setting. This introduces a need for evaluation of the nutritional quality of foods in the emergency food system in a way that will properly quantify the impact of these initiatives on nutrients of concern such as sodium.

Prior Research

One of the earliest efforts to assess the broader food environment in food banks involved sorting and weighing foods in MyPyramid food groups in order to determine if food bank offerings are sufficient to meet a client's recommended intake from each group.[12] A more recent attempt at answering this question featured a similar methodology, but reflected MyPlate food groups rather than MyPyramid.[13] The methodologies employed in these studies were the first to provide a general picture of food bank offerings in rough categories and could be useful for food banks in determining where their inventories may be lacking. However, they had little relevance in terms of determining specific nutritional content of a food bank's offerings given their focus on broad food groups rather than specific food items.[12,13]

Further studies attempted to focus more specifically on the nutritional content of food bank offerings by utilizing scoring systems. The first was the Choose Healthy Options Program (CHOP) ranking system, which utilizes formulas embedded in an Excel spreadsheet to assign a food item a score of 1, 2, or 3 (choose frequently, choose moderately, or choose sparingly, respectively). This method relies on manual entry into the spreadsheet for seven positive nutrients (iron, fiber, calcium, folate, vitamins A, C, and D) and four negative nutrients (saturated fat, cholesterol, sodium, added sugars) found on food item nutrition labels. While this method allows for tracking of the sodium content in specific items, it is for the purpose of creating an aggregate score for a food item based upon all of the nutrients collected. Considering that the CHOP spreadsheet is not connected to a nutrient database, this route offers no advantage over manual collection of sodium content.[14]

Another scoring system that was implemented in the food bank setting is the Healthy Eating Index 2010, which aims to describe the healthfulness of a food bank's total offerings on a scale from 0-100 and includes a sodium component score ranging from 0-10. However, this method relies on analysis of food pantry purchasing records and provides no insight into how one might also capture donated food items which may make up the majority of food bank offerings. A similar scoring system termed the Hunger Relief Nutrition Index was later developed, which utilizes product weight for the basis of normalization rather than calories (as the Healthy Eating Index does). This allows for data collection that consists simply of sorting foods into designated categories and weighing them.[16] However, both of these scoring systems focus only on providing an aggregate sodium score for total food bank offerings and do not differentiate sodium content between particular food groups or items.[15,16]

Literature Gap and Project Aim

While there are some attempts to quantify the nutritional quality food distributed by the emergency food system in the available literature, none provide a methodology that might be adapted to collect data on the sodium content of food groups or specific food items. Nor do they identify methods that could capture both purchase and donated foods. This limits the ability of food bank directors and policymakers to evaluate implemented actions aimed at reducing particular nutrients of concern, such as sodium. As such, the goal of this thesis project was to develop and pilot test a methodology to assess the sodium content of food bank offerings. The necessity of this project arose from a need to facilitate baseline and ongoing data collection to assess the impacts of a CDC sodium reduction intervention in multiple food banks in King County, Washington.

After completing a literature review, the research team visited several food banks and pantries in King County in order to gain insight into the potential challenges and opportunities for evaluation in this setting. It quickly became apparent that the most notable challenge to developing a methodology for evaluation is the variation that exists in this setting on multiple levels. Examples of this include:

1. Variation in foods received

Food banks and food pantries receive foods from a variety of sources such as government commodity programs, food drives, grocery stores, restaurants, and other community partners in addition to making purchases (typically through wholesale outlets and programs). As such, there is significant variation in the types of food items received as well as their quantities and packages sizes. The volume of foods distributed can also vary between the beginning and end of the month, in summer versus winter months because of changing availability of fresh produce, and around the holiday season. There are also logistical barriers to data collection such as inconsistent availability of bar codes and nutrition information on food packaging.

2. Variation between food banks

Food banks vary from one another in terms of the sources of donated foods, the number of days and times that they are open or allow clients to visit, and the format through which they distribute foods. For example, some food pantries pre-bag foods for distribution, while others use self-select models that allow clients to choose a certain number of items (typically determined by household size) per food category. There are also models that are designed to resemble grocery stores.

3. Lack of tracking

There is little tracking in terms of the quantity and type of food items that are procured from each source, or when particular food items will be distributed. Most tracking is completed by weighing donations as they arrive and assigning them to vague categories (e.g. canned and dry foods, breads and pastry, produce, etc.) and the recording of donation source can range from specific grocery stores to 'church/community' food drives. Overall, food banks can vary considerably in the extent to which they track donations, though none featured records that went beyond the detail of broad categories.

In order to develop a methodology that could be applied from food bank to food bank, each of these factors were accounted for to the best of our ability. This novel methodology and pilot test provides insight into one of the first attempts to quantify the specific nutritional content of foods in the emergency food setting.

Methods

Study Setting

Data collection for this cross-sectional study was completed at the Des Moines Area Food Bank in King County, WA in January, 2017. Des Moines Area Food Bank is an urban food bank that distributes approximately 110,000 pounds of food to over 1,000 households in the city of Des Moines, the majority of the city of SeaTac, and the South Hill neighborhood of Kent each month.[17] The majority of this food is procured through donations from grocery stores, local businesses, community and organization food drives, the USDA government commodity program (TEFAP), and larger food bank distributers (Northwest Harvest). Des Moines Area Food Bank is open three days per week for a three-hour service in the mornings and once a month in the evening. Clients in the food bank service area are allowed to visit the main food line once a month. In addition, there is a separate 'bread room' of bakery-style breads and produce items such as potatoes and onions that clients can visit an unlimited amount of times. The food bank follows a self-select model that allows clients to choose items they prefer as they walk through the main food line. Food items from similar food categories are grouped into bins. Each bin is labeled with household allotment numbers which determine the number of items clients can take from each bin as they travel through the service line depending on their household size. Households are defined as small (1-2 people), medium (3-5 people), and large (6-10 people).

Data Collection

Data collection took place on January 13, 2017 and was completed by a team of two research coordinators, two employees of Des Moines Area Food Bank, one graduate student, and one public health official. Two tracking sheets were developed to collect information about the food bank and contents of bins. The first was completed prior to and at end of the shift and involved a map of each bin and its respective category label, as well as the number of clients served during that morning's shift by household size. The second tracking sheet corresponded to specific bins and included fields to describe the bin's contents, household allotment numbers, and information about specific food items in the bin: item name, brand name, type (low-sodium, light, etc.), packaging type, amount, weight/unit, servings, calories per serving, sodium per serving, quantity in the bin, and the presence of a barcode and nutrient label on packaging.

Data collectors arrived in the morning and took the inventory of the bins prior to the start of the food bank shift. While we sought to represent the full scope of the food bank's offerings, there were feasibility issues that prevented all bins from being evaluated. Due to the limited amount of time we had before the food bank opened, we prioritized data collection for bins we expected to have high sodium based on existing data of high-sodium food categories.[18,19] We excluded produce, fresh meats from data collection because they often lack nutrition labels and are low in sodium compared to other bin categories. Dry noodles, rice, and oats were also excluded because they are low in sodium and the lacked variation (in most cases, these bins contained only one type of item). In addition, we excluded juice, milk, hummus/cottage cheese/dips, canned juice, and popcorn because we were not able to complete data collection before the start of the food bank shift and the locations of these bins made data collection too disruptive during service. There were other miscellaneous categories that were also excluded because of the wide variability of these items. Finally, we excluded data collection of the 'bread room' due to its high variability and the fact that clients can take unlimited quantities of items from this space throughout the month as needed.

After these exclusions, data collection was completed for the following bin categories: mixed snacks, mixed canned vegetables, tomato products, canned meat, canned soups and beans, boxed meals, cheese, frozen meals, fresh prepared meals (e.g. individually-packaged sandwiches and salads), sliced bread, pastry, dry goods, yogurt, mayo/dressings, canned fruit, and government commodities (peanut butter, kidney beans, cereals, and nuts). The data collection team completed an initial inventory of the items offered in each bin prior to the start of the food bank shift. When the shift began, some bins were continually replenished and these items were added to the inventory list for approximately the first hour of the shift. However, this was infeasible for all bins and was not completed for the mixed snacks, yogurt, fresh prepared meals, and pastry bins. At the end of the shift, the number of clients served by household size was recorded.

Analysis

The tracking sheets for each bin were compiled and entered into Excel. Missing values for items lacking a nutrition label (n=32) were estimated using the USDA Food Composition database[20]. For each bin category, mean sodium per serving, mean sodium per 100kcals, mean sodium distributed per client visit, and the minimum detectable effect size were calculated.

Mean Sodium (mg) per Serving

For each bin, the mean and standard deviation of sodium per serving were calculated in Excel by weighting sodium per serving for each food item by number of servings in the item and by total quantity of the item in the bin. Serving size for each food item was defined by serving size on the food package label, which are designed in accordance with the FDA reference amounts.[21]

Mean Sodium (mg) per 100kcals

For each bin, the mean and standard deviation of sodium per 100kals were calculated in Excel by converting the ratio of sodium per serving and calories per serving into sodium per 100kcals for each item. A weighted mean of sodium per 100kcals for each bin was calculated by accounting for the quantity of each item in the bin.

Mean sodium (mg) distributed per client visit

Mean sodium distributed per client visit was calculated in Excel. For each bin, a weighted mean of sodium per item was calculated by taking an item's quantity into account as in the analysis methods described above. Assumptions used to approximate the amount of sodium that a client would take home from each bin were based upon estimates from the Des Moines Area Food Bank staff. For example, staff informed us that clients typically take the maximum household allotments for all bin categories. We also assumed clients would visit once per month in adherence with the food bank's rules and that a client's food would last 11 days based on estimates of 10-12 days by the Des Moines Area Food Bank staff.[17] For sliced bread, which can be taken in unlimited amounts, staff estimated that clients typically take home 1, 2, or 3 loaves based on their household size. Finally, we assumed the number of clients in each household size category were at the midpoint of the ranges (1.5 for small households, 4 for medium, and 8 for large).

Minimum Detectable Effect Size

The minimum detectable effect size was calculated for each bin in Stata 14.2 and indicates the smallest change in sodium (mg) needed to detect a difference from the mean sodium per serving at follow-up visits with 80% power and alpha set to 0.05. We used a paired means t-test under the assumption that some of the items would be similar on a return visit given that the food bank regularly receives donations from similar sources. To gain a sense of how the minimum detectable effect size would change based on how correlated the paired observations are, we tested a range of correlation values (.1, .2, .3, and .4). It was also assumed that the standard deviation (variation of items) and sample size would be approximately the same at follow-up visits. Dry goods (lentils) and government commodity peanut butter and kidney beans were excluded from this analysis because these bins had a standard deviation of 0.

Results

The information for 306 unique items (n=1,395 total) was recorded and analyzed. The mean sodium (mg) per serving and per 100 kcals, each by food category, are presented in Table 1 below. In regard to mean sodium per serving, fresh prepared meals had the highest mean sodium per serving, followed by boxed meals, canned soup/beans, tomato products, and pastry. There was considerable overlap in the bin categories with greatest mean sodium per 100kcals with tomato products being the highest, followed by mixed canned vegetables, canned soup/beans, canned meats, and boxed meals. This is primarily due to the fact that sodium per 100kcals is a measure of sodium density and does not reflect the typical amount (serving) consumed by an individual. However, sodium per 100kcals could be a useful measure in identifying additional bin categories that contribute high amounts of sodium to one's diet.

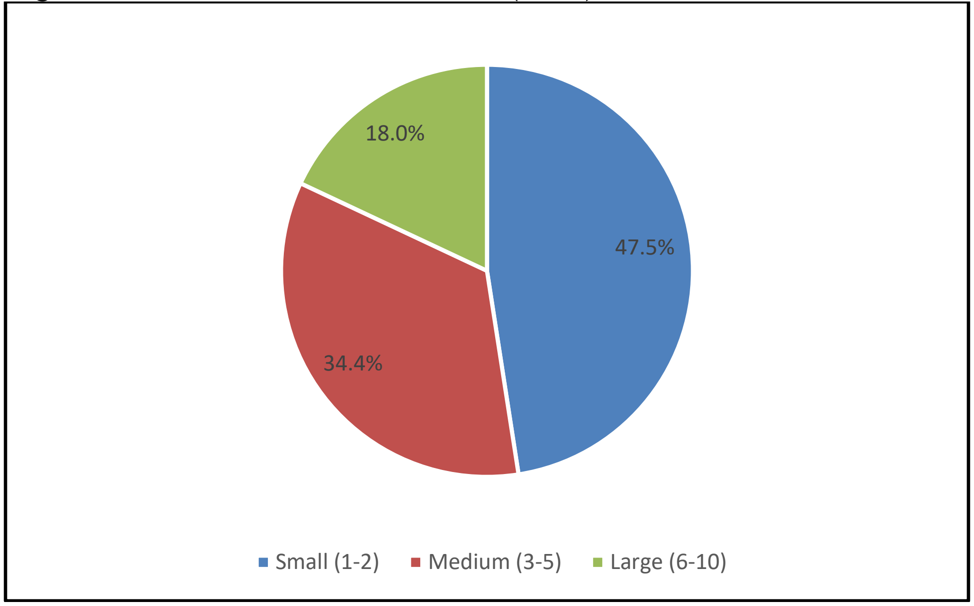
Table 1: Mean Sodium (mg) per serving and 100kcals, by bin food category

Bin Category	**Mean Sodium [mg] per Serving (s.d.)**		**Mean Sodium [mg] per 100kcals (s.d.)**		**Number of Items (n= 1395)**
Fresh, Prepared Meals	1	1138 (593)	6	312 (117)	48
Boxed Meals	2	719 (192)	5	372 (111)	184
Canned Soup, Beans	3	506 (269)	3	838 (1593)	164
Tomato Products	4	294 (134)	1	990 (685)	75
Pastry	5	265 (181)	13	96 (68.3)	67
Canned Meats	6	254 (174)	4	487 (517)	115
Mixed Canned Vegetables	7	216 (119)	2	946 (819)	113
Frozen Meals	8	204 (149)	7	214 (296)	9
Sliced Bread	9	182 (53.7)	9	175 (44.3)	78
Cheese (B2)	10	172 (22.0)	8	180 (57.9)	30
Gov. Comm.- kidney beans	11	140 (0.0)	11	140 (0.0)	69
Mixed Snacks	12	122 (56.1)	12	119 (52.2)	38
Cheese (B1)	13	119 (62.1)	10	161 (66.7)	125
Gov. Comm. - cereal	14	97 (105.6)	16	77 (96.6)	37
Yogurt	15	96 (46.7)	15	83 (37.1)	31
Mayo, Dressings	16	87 (16.5)	14	87 (16.7)	50
Gov. Comm. - peanut butter	17	65 (0.0)	19	36 (0.0)	56
Gov. Comm. - nuts	18	55 (87.8)	17	55 (83.7)	33
Canned Fruit	19	28 (17.8)	18	51 (25.1)	55
Dry Goods (lentils)	20	5 (0.0)	20	7 (0.0)	18

The standard deviation of both mean sodium per serving and mean sodium per 100kcals indicates a considerable variation in the sodium content of inventoried items in the majority of bin categories. For example, the mean sodium per 100kcals for canned soup and beans was 838mg with a standard deviation of 1593mg due the variety of brands and types (i.e. 'low-sodium', 'light', etc.) of items in this bin. For the bin categories in which the standard deviation was zero (dry goods [lentils], as well as government commodity kidney beans and peanut butter), it was because only one unique item was available in the bin.

The distribution of client household size on the day of data collection is described in Figure 1. Small households of 1-2 people were most common (47.5%), followed by medium (3-5 people) and large household sizes (6-10 people).

Figure 1: Household size distribution (n=61)

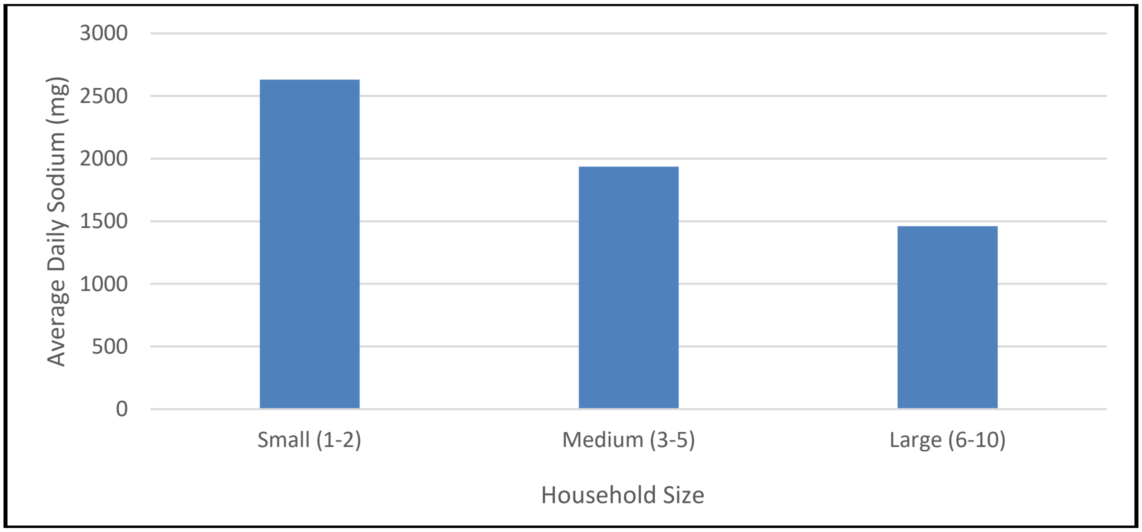


As described above, the mean daily sodium contribution from these bins at Des Moines Area Food Bank was based on one client visit per month, the midpoint number of clients per household for each household size tier, clients taking the maximum allotment values for these bins, and that the food would last them approximately 11 days. The mean daily sodium contribution by household size was calculated for each bin (Table 2). The bins contributing the most sodium per day were pastry, tomato products, fresh prepared meals, sliced bread, and mixed snacks. These bin categories are slightly different from those with the highest mean sodium per serving because it is based upon the amount of sodium in the total item. Additionally, it incorporated household allotment values, which varied by bin category. The total daily sodium contribution from these bin categories is shown in Figure 2. It is estimated that a client living in a small household would consume 2630mg sodium per day from the Des Moines Area Food Bank food categories analyzed, while a client in a medium household would consume 1937mg and from a large household, 1460mg (Figure 2). These findings indicates that a client in a small household may exceed the recommended sodium limit of 2,300mg per day from food they receive at Des Moines Area Food Bank. In addition, this is likely an underestimation as not all bin categories were included in data collection and analysis and these would likely contribute additional sodium. Clients may also receive food (and therefore sodium) from other sources.

Table 2 – Mean daily sodium contribution (mg) per client by bin and household size

Bin Category		**Small Family (1-2)**	**Medium Family (3-5)**	**Large Family (6-10)**
Pastry	1	370	278	208
Tomato Products	2	368	276	207
Fresh, Prepared Meals	3	345	259	194
Sliced Bread	4	207	155	116
Mixed Snacks	5	194	146	109
Mixed Canned Vegetables	6	189	142	107
Canned Soup, Beans	7	176	99	82
Cheese (B2)	8	176	132	99
Mayo, Dressings	9	126	95	71
Boxed Meals	10	109	82	61
Gov. Comm. - peanut butter	11	63	47	35
Gov. Comm. - cereal	12	58	44	33
Frozen Meals	13	52	39	29
Cheese (B1)	14	51	38	29
Gov. Comm. - nuts	15	40	30	23
Canned Meats	16	36	27	20
Gov. Comm.- kidney beans	17	30	22	17
Yogurt	18	20	15	11
Canned Fruit	19	13	8	5
Dry Goods (lentils)	20	7	5	4

Figure 2: Mean daily sodium intake (mg) by client, from foods provided by Des Moines Area Food Bank



Minimum detectable effect size, indicating the smallest change in sodium (mg) needed to detect a difference from the mean sodium per serving at follow-up visits, is described for correlation values between sample means of .1 and .2 in Table 3. The bin category with the largest minimum detectable effect size was fresh, prepared meals (217-230mg) and the smallest was canned fruit (6mg). The percentage difference in mean sodium per serving that would need to be achieved to observe a change at follow up was the smallest for boxed meals (5-5.3%) and largest for government commodity nuts (70.7%). Of the five bin categories with highest mean sodium per serving (fresh prepared meals, boxed meals, canned soup and beans, tomato products, and pastry), pastry requires the largest percent difference in mean sodium per serving to observe a change at follow-up (21.1-22.3%).

Table 3 – Minimum detectable effect size in sodium (mg) by bin category

	Correlation = .1		*Correlation = .2*	
Bin Category	**Difference in Sodium (mg)**	**% Difference**	**Difference in Sodium (mg)**	**% Difference**
Boxed Meals	38	5.3	36	5.0
Cheese (B2)	11	6.3	10	5.9
Mayo, Dressings	6	7.2	6	6.8
Sliced Bread	16	9.0	15	8.4
Canned Soup, Beans	56	11.1	53	10.4
Cheese (B1)	15	12.4	14	11.8
Mixed Canned Vegetables	30	13.8	28	13.1
Tomato Products	41	14.1	39	13.3
Canned Meats	43	17.0	41	16.1
Mixed Snacks	25	20.1	23	18.9
Fresh, Prepared Meals	230	20.2	217	19.0
Pastry	59	22.3	56	21.1
Canned Fruit	6	22.9	6	21.8
Yogurt	23	23.6	21	22.3
Gov. Comm. - cereal	47	48.2	44	45.5
Frozen Meals	140	68.7	132	64.8
Gov. Comm. - nuts	41	74.9	39	70.7

Discussion

Our pilot methodology allowed us to explore mean sodium per serving and per 100kcals, as well as the mean amount of sodium distributed to clients for the majority of bin categories at Des Moines Area Food Bank. Fresh prepared meals were found to have the highest mean sodium per serving, followed by boxed meals, canned soup/beans, tomato products, and pastry. The bin categories with greatest mean sodium per 100kcals differed slightly with tomato products being the highest, followed by mixed canned vegetables, canned soup/beans, canned meats, and boxed meals. It was also estimated that the amount of sodium consumed by a client from the bin categories analyzed would be 2630mg sodium per day for a small households, 1937mg for medium households, and 1460mg for large households. Finally, we calculated the minimum detectable effect size using a paired means t-test with 80% power, which provides guidance for future evaluation efforts in terms of how much the mean sodium per serving in each bin will need to change in order to show an impact of implemented strategies. The bin category with the smallest minimum detectable effect size was canned fruit (6mg) and the largest was fresh prepared meals (217-230mg). The percentage difference in mean sodium per serving that would need to be achieved to observe a change at follow up was the smallest for boxed meals (5-5.3%) and largest for government commodity nuts (70.7%). Of the five bin categories with highest mean sodium per serving (fresh prepared meals, boxed meals, canned soup and beans, tomato products, and pastry), pastry requires the largest percent difference in mean sodium per serving to observe a change at follow-up (21.1-22.3%).

The bin categories identified with the highest mean sodium per serving and per 100kcals are consistent with those that we expected to be higher based on Vital Signs national sodium consumption data and Feeding America's Foods to Encourage guidelines.[18,19] This suggests that our methodology could be a viable tool in determining the highest sodium contributors at specific food banks and could provide guidance for food bank managers in terms which categories to focus on in developing strategies for procuring and promoting lower sodium alternatives.

Our findings for mean sodium distribution by Des Moines Area Food Bank are also novel in that, to our knowledge, there are no prior attempts to describe the amount of sodium distributed in food bank offerings to clients. Our results indicate that a client in a small household may exceed the recommended sodium limit of 2,300mg per day from food they receive during a visit to Des Moines Area Food Bank (with the estimated amount being 2,630mg). In addition, this is likely an underestimation as some bin categories were excluded from data collection and analysis: produce, fresh meats, dry noodles, rice, oats, juice, milk, hummus/cottage cheese/dips, canned juice, and popcorn. These bin categories, particularly hummus/cottage cheese/dips and popcorn, would likely contribute additional sodium if included. Clients may also receive food (and therefore sodium) from other sources such as food assistance programs. These findings are limited by the assumptions made in regard to the number of items from each category a client would take, number of people per household, and how many days food would last. Even so, they suggest that clients receive a considerable amount of sodium during a food bank visit from these bin categories alone.

Another strength of our study was the calculation of minimum detectable effect size, which provides insight into the feasibility of sodium reduction in each bin category. The percent change in sodium needed to obtain a meaningful difference from the mean at follow-up visits ranged from 5-70.7% for bin categories. However, was 22.3% at highest for the top five bin categories with highest mean sodium per serving. Previous grantees in the CDC Sodium Reduction in Communities Program were successful in reducing sodium in a variety of venues. For example, the Los Angeles County Department of Public Health reduced the mean sodium per snack package by 30% in vending machines located on government sites and the San Antonio Metropolitan Health District decreased average sodium content of meals at a private worksite by 22%.[7] These reductions combined with the minimum detectable effect size results suggest that it is feasible to implement strategies with a measurable impact in the food bank setting, particularly by focusing on the bin categories with highest mean sodium per serving.

Despite the strengths of our developed methodology and pilot test results, there are some potential limitations to our study's generalizability. Data collection was performed on only one day, which likely contributed to the high variability of the data. In addition, this data is limited to the food bank inventory at the time of data collection (January 2017), and may not be applicable in other weeks, months, or seasons. Data collection excluded some bin categories (produce, meat, juice, milk, hummus/cottage cheese/dips, dry noodles, oats, rice, canned juice, meats, popcorn, and other miscellaneous categories). Nor did it include all foods offered within each bin category based on feasibility issues. There were also several assumptions made during data analysis. For example, nutrition labels were missing on 32 products (the majority being pastry items) and this information was estimated using the USDA Food Composition Database. Some assumptions were also made to calculate a client's typical sodium intake from the food categories analyzed, as described in the Methods section above. In addition, the only way to detect a change in daily sodium intake per client while using this methodology would be if a bin's mean sodium per serving was to change by an amount larger than the values identified by the minimum detectable effect size calculation.

Future evaluation efforts should work to strengthen this methodology by conducting repeat assessments to determine variation in food item distribution over days, weeks, months, and seasons. In addition, researches should work with food bank staff in order to find ways to accomplish a complete assessment of items distributed during the full sample service. This could be made easier by incorporating the use of a bar code scanner that links food items to an appropriate nutrient database, given that over 90% of items had bar codes. Finally, it would be useful for future efforts to pilot test this methodology with food banks utilizing other client selection models in order to greater understand its generalizability.

Overall, the methodology and pilot test that were developed and conducted in this study have some potential limitations in regard to generalizability. Despite this, our findings contribute novel data on the sodium content of food bank offerings as well as perspectives on the feasibility of data collection in this venue.

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Appendix

Emergency Food Bin Data Collection Form

Name of Food Bank: ______________________________

Date/day of data collection: ______________________________

Food Bank Opening Hours: Start time: _______ End time: _______ Total hrs: ______

Data Collection Shift: Start time: _______ End time: _______ Total hrs: ______

Data Collection Team Members:

Notes about Food Bank shift:

Total number of food bank clients during daily shift: __________

Number of food bank clients by household size:

Size	#

Draw a map of food bank line (# bins for reference to other forms):

Emergency Food Bin/Item Data Collection Form

Bin #:

Bin content category:

General description of bin contents:

Household size allotments (# each person can take from this bin), if noted:

Small (1-2 people): Medium (3-5 people): Large (6+ people):

ITEMS IN BIN:

Quantity (use tick marks each)	**Item name**	**Brand / Manufacturer**	**Details/ type** (e.g., flavor, light/diet /low sodium)	**Unit type** (can, box, package, box)	**Weight / unit** (ounces, pounds, grams)	**# servings** /unit	**Cals / serving**	**Sodium (mg) / serving**	**Bar code** (Y/N)	**Nutr label** (Y/N)