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THE EFFECT OF FOOD DONATIONS ON THE MICRONUTRIENT INTAKE OF SOUP KITCHEN CLIENTS

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THE EFFECT OF FOOD DONATIONS ON THE MICRONUTRIENT INTAKE OF SOUP
KITCHEN CLIENTS

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University of Connecticut

Honors Undergraduate Thesis in Nutritional Sciences

April 2018

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Background

For the past two years, this author has been the director of Food Recovery, a volunteer organization in UConn Community Outreach. Community Outreach is a program that oversees over 100 student directed community service programs that collaborate with UConn's neighboring towns to meet self-identified community needs. Food Recovery's mission is two-fold: to decrease UConn's food waste and to aid Covenant Soup Kitchen in feeding those experiencing food insecurity in Willimantic, Connecticut. Food Recovery began as an organization in 2007, as students felt a need to decrease the food waste generated by UConn Dining Services and wanted to take action. By working with Dining Services, undergraduate students volunteered to save the surplus food from UConn (UC) Cafés during the semester and transported it to Covenant Soup Kitchen on Monday through Friday mornings, and continue to do so to this day. The UC Café foods were pre-packaged sandwiches and salads made fresh daily by Dining Services, and Food Recovery volunteers collected food items the following day that were not sold. Although Food Recovery was started as a response to food waste, the food items provided options for lunch for the soup kitchen clients, and were often taken as a to-go meal to eat later in the day.

The Covenant Soup Kitchen offers hot breakfast and lunch Mondays through Saturdays and dinner on Fridays. At each lunch, 100-120 guests are served, and the kitchen offers protein (usually meat), grain, and cooked vegetable options, as well as a tossed green salad and fruit salad, bread and butter, dessert, and water and juice. Additionally, vegetarian and dairy free options are offered to those with dietary restrictions. The kitchen also provides an emergency food pantry to clients once a month. The kitchen relies heavily on donations of processed, fresh, and ready to eat foods. It receives many donations from the Manchester Big Y supermarket and

local churches and schools, with many ready to eat foods donated by Eastern Connecticut State University and UConn. Because the donations are variable, the kitchen works with the ingredients available on a given day to provide clients a warm, good tasting meal. Health is not a priority for the soup kitchen clients and the kitchen lacks the staff, time and equipment for nutritional analysis of the items served, so it is unknown what nutrients the foods provide in a given day.

Food Recovery's efforts have been successful, as they have increased Dining Service's awareness of food waste. In response, Dining Services now closely tracks its sales and food orders to decrease waste from the source. With the second program mission of providing food to people experiencing food insecurity, the items donated provide energy and options for the clients. The ingredients for the food items donated by Food Recovery are displayed on the packaging, but the nutrition information is only accessible on the UConn Dining Services website. With the lack of nutrition information for the food items provided from Food Recovery and Covenant Soup Kitchen, it was unknown what nutrients and quantities of nutrients were in the foods available for consumption to kitchen clients.

People experiencing food insecurity are especially prone to hypertension, a diet sensitive disease. The data of four micronutrients that directly impact blood pressure (sodium, potassium, calcium, magnesium) within the donated and prepared foods indicated if the foods had a positive or negative impact on blood pressure. Data analysis also determined the effectiveness of Food Recovery in providing food items that not only supplied energy, but also had a potential positive impact on the health of the soup kitchen clients.

Review of the Literature

What is food insecurity?

The United States Department of Agriculture (USDA) defines food security as “access by all members (of a household) to enough food for an active, healthy lifestyle” (USDA, 2017). Being food secure ensures a household has access to nutritionally adequate foods, and can obtain these foods in socially acceptable ways. The USDA measures food security in four different categories. The “low food security” and “very low food security” categories are defined as being food insecure, meaning households do not have access to nutritionally adequate or desirable foods, access to enough food, or cannot obtain foods in acceptable ways. Food insecurity can also mean a household consumes decreased quality or variety of foods, and members may have disrupted eating patterns due to an inability to obtain or purchase food (USDA, 2017).

The greatest indicator of experiencing food insecurity in the United States is having an annual income close to, at, or below the federal poverty level ("Poverty Guidelines," 2018). The federal poverty level is dependent on how many people live in a household, and is primarily used as a threshold to measure if a household is eligible for certain federal assistance programs, such as food assistance or Medicaid. For example, the federal poverty level for a family of four in 2018 is an annual income of \$25,100 or less ("Poverty Guidelines," 2018). The more a household's yearly income is below the poverty level, the more likely it is to be food insecure (Goldberg & Mawn, 2015). In 2016, 12.9% percent of United States households were food insecure and 35.7% of all households at or below 130% of the poverty level were food insecure (Coleman-Jensen et al., 2017). In 2015, 11.6% of people in Windham County, Connecticut were food insecure, which illustrates how food insecurity is a national and local problem (Connecticut Food Bank, 2015).

In the United States, food insecurity is more likely to impact racial-ethnic minority households. According to the 2016 USDA Current Population Survey Food Security Supplement graph, 22.5% of Black-headed households and 18.5% of Hispanic-headed households were food insecure, compared to 9.3% of non-Hispanic White-headed households (USDA ERS, 2018). Living in a household headed by a single parent also increases likelihood of being food insecure because of income limitations. In 2016, 66% of Black children and 42% of Hispanic children lived in single parent households, compared to 24% of non-Hispanic white children (“Children in single-parent families,” 2018). Households headed by a single woman are most at risk of food insecurity, with rates at 32% in 2017 (“Poverty and Hunger Fact Sheet,” 2017). As these data suggest, food insecurity disproportionately affects minorities in the United States.

In response to national and local food insecurity, various federal and local programs have been implemented. The Supplemental Nutrition Assistance Program (SNAP) is a major government funded program that works to combat food insecurity in the United States (“Am I Eligible for SNAP?,” 2018). SNAP provides monthly monetary assistance to purchase food items for individuals and households whose annual income is at or below 130% of the federal poverty line. SNAP benefits can only be used to purchase unprepared food items, and there are no current regulations or restrictions on what types of foods can be bought using SNAP, such as restricting soda purchases. The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) is a federal program that provides food assistance for pregnant and nursing women and children up to age 5, and also provides specific guidelines for what foods can be purchased (“USDA Nutrition Assistance Programs,” 2018). WIC eligible foods include whole grain breads and pastas, low fat milk, produce, and infant formula and cereals (“WIC Food

Packages," 2018). The National School Lunch Program (NSLP) is another federal program that provides free or low cost lunch to eligible school children grades k-12, with schools preparing and serving foods according to strict federal nutritional guidelines ("USDA Nutrition Assistance Programs," 2018).

The aforementioned programs all have income cutoffs that may disqualify those who need assistance, and a lengthy application process. Even though SNAP is only available to families whose annual income is at or below 130% of the federal poverty level, 33% of the food insecure population in Windham County in 2015 had an income level above the SNAP cutoff level (Map the Meal Gap, 2015). In response to the federal assistance coverage gap, emergency food assistance programs provide food to people regardless of federal assistance status. Soup kitchens are local programs that provide cooked meals, whereas food pantries provide food staples that people can use in their own kitchens. There are some emergency food programs that are nationally affiliated, such as the Connecticut Food Bank, but 53% of soup kitchens nationally are religiously affiliated (Greenberg et al., 2010). Soup kitchens often have tight budget constraints and are forced to rely heavily on funds from city and state governments, as well as donations from supermarkets, the general public, and universities to feed their clients (Koh, et al., 2016).

Health effects of food insecurity

The homeless are the most vulnerable population to food insecurity due to lack of reliable housing, food sources, and high levels of personal stress. Many homeless people throughout the world experience fat and muscle wasting from a lack of consistent access to healthy food, however this is not the case in the United States (Leung et al., 2012). In 2012, 32.3% of the homeless adult population in the U.S. was obese, with only 1.6% categorized as underweight.

This value is not significantly different than the obesity rate of the total U.S. adult population. Obesity rates have doubled from 1990 to 2017 (15% to 32%) and have reached health epidemic levels (Koh et al., 2012).

Homeless or not, food insecure individuals in the U.S. are at a higher risk of obesity than a food secure individual. A cross-sectional study analyzed height, weight, and USDA Household Food Security Survey answers from women ages 18 and older (Adams et al., 2003). After controlling for income level, researchers found women living in food insecure households were more likely to be obese, by an average of two BMI points, than women living in food secure households (Adams et al., 2003). This phenomenon has been named the “Food Insecurity-Obesity Paradox” by scholars, as rapidly increasing obesity rates are correlated with increasing food insecurity (Dinour et al., 2007). A major hypothesis for the Food Insecurity-Obesity paradox is the relationship between income level and diet quality. According to the Hunger in America 2014 survey, food insecure households used many different coping strategies to fulfill their food needs, with 83% of households choosing to buy inexpensive, unhealthy food as a strategy (“Causes and Consequences of Food Insecurity,” 2018). Nutritious foods, such as fruits and vegetables, are more expensive than unhealthy processed foods, as processed foods may provide more calories per dollar than produce (Laraia et al., 2017). Other strategies used to cope include choosing between paying for rent or food, and watering down food or drinks to make them last longer. These coping strategies, along with living on food budget shortages over an extended period of time not only contribute to obesity, but contribute to an increased likelihood of developing a diet sensitive chronic disease, such as hypertension or diabetes (Seligman et al., 2010).

Seligman and colleagues (2010) analyzed NHANES data from 1999-2004 of over 30,000 adults between 18-65 years old to establish if there is a correlation among food insecurity, low income, and chronic disease. The chronic disease measured was clinical hypertension, defined as having blood pressure at or above 140/90 mm Hg (Seligman et al., 2010). Hypertension can increase the risk of cardiovascular disease and stroke, and can also increase risk of new-onset diabetes (“Health Threats From High Blood Pressure,” 2018). 22.4% of food insecure adults had clinical hypertension, compared to 18.6% of food secure adults. Food insecure adults also had a 22% greater chance of becoming hypertensive than food secure adults (Seligman et al., 2010). A study of a 4.1 million adults in the United Kingdom with no cardiovascular disease or diabetes analyzed the effects of a 20 mm Hg increase in systolic blood pressure and a 10 mm Hg increase in diastolic blood pressure from a 110/70 mm Hg baseline. Researchers found the systolic increase lead to a 58% greater risk in acquiring new-onset diabetes, and the diastolic increase lead to a 52% greater risk (Emdin et al., 2015). Diabetics are two to four more times more likely to die of heart disease than people without diabetes, and are at increased risk of renal disease, vision damage and nerve damage (“Why Diabetes Matters,” 2018). These data imply that the link between food insecurity and hypertension can have drastic impacts on individual health over the course of a lifetime.

Importance of micronutrients in preventing and controlling hypertension

Researchers have identified four micronutrients that can directly influence blood pressure: sodium, potassium, calcium, and magnesium. Sodium has a direct relationship with blood pressure, whereas the other micronutrients have an indirect relationship with blood pressure (Reusser & McCarron, 1994). Appel (2017) recommends guidelines to manage high blood pressure by limiting sodium intake, increasing potassium intake, and following the Dietary

Approaches to Stop Hypertension (DASH) diet established by the National Heart, Lung and Blood Institute (NHLBI) (Appel, 2017). The DASH diet recommends limiting sodium intake and eating a diet rich in fruits, vegetables, and whole grains, which are excellent sources of potassium, calcium, and magnesium (“DASH Eating Plan,” 2018). Hypertension can be caused by a lack of consuming the essential minerals that promote cardiovascular health (Seligman et al., 2010). Lacking these minerals and food sources in the diet can prevent successful disease management, as unmanaged hypertension can lead to further cardiovascular complications and heart disease.

A CDC study analyzed the effectiveness of a home blood pressure monitoring intervention with New York City residents (Grilo et al., 2015). Food secure participants had a significant reduction in blood pressure during the intervention, while food insecure participants did not (Grilo et al., 2015). This study shows a relationship between food access and ability to manage hypertension, and how medical interventions meant to decrease hypertension can be ineffective if someone is experiencing food insecurity. A different study tracked the mean sodium and mean potassium intake of food secure and insecure adults using 2007-2010 NHANES data (Nothwehr, 2014). Researchers found the difference in mean sodium intake between food secure and insecure adults to be negligible, but the mean potassium intake of food secure adults was significantly greater than for food insecure adults. The mean sodium/potassium ratio for food insecure adults was much greater than for food secure adults. This micronutrient ratio lead researchers to calculate that food insecure adults are 43% more likely to be hypertensive than food secure adults (Nothwehr, 2014).

A factor other than diet that can influence hypertension risk is cigarette smoking. 30-40% of people of low socioeconomic status smoke cigarettes, compared to the total U.S.

smoking population of 16.8% (Perkett et al., 2017). The combination of food insecurity and increased rates of smoking puts low socioeconomic groups at a disproportionately higher risk of poor cardiovascular health than the average U.S. population. Perkett and colleagues (2017) evaluated the health of clients at a soup kitchen. Of the 144 participants, 50% were smokers and 72.3% had hypertension, which was the highest reported chronic disease within the sample, followed by diabetes (Perkett et al., 2017). Researchers concluded that people utilizing food pantry services are at high risk of poor cardiovascular health from the combination of frequent smoking, hypertension, and food insecurity. Dietary interventions such as preparing foods with high potassium levels or low sodium levels at soup kitchens could aid in hypertension control (Perkett et al., 2017).

Foods served at soup kitchens

The foods and meals served at emergency food sites are not always optimal for promoting health and decreasing disease risk. Currently, no national nutrition standards exist for foods served in soup kitchens. Many kitchens receive the majority of their foods from public drives and local restaurants, and consequently have high fat and carbohydrate values (Koh et al., 2016; Sisson & Lown, 2011). Nutrition analysis of 41 meals in 3 urban soup kitchens in Michigan revealed the mean nutrient content of a meal did not meet the estimated average requirement for energy, vitamin C, magnesium, zinc, dietary fiber or calcium (Sisson & Lown, 2011). The estimated average requirement (EAR) was defined as the median intake to meet half the population's daily-recommended intake values. Eating two meals at a kitchen was enough to meet the EAR in magnesium and zinc intake, but also provided high values for energy, saturated fat, and sodium (Sisson & Lown, 2011). These high values have concerning health implications,

as over-consuming sodium over time can increase hypertension risk and over-consuming saturated fat and calories can contribute to weight gain and obesity.

The fact that emergency food sources have to rely so heavily on donations to feed their clients is a barrier to improving the nutrient quality of the meals served. It is estimated that pantries in the United States receive at least 50% of their food from donations, with some community programs receiving up to 90% of their food from these sources (“How We Work - Community Food Share,” 2018.; Zhu et al., 2014). The University of Wisconsin Extension Program developed a tool to grade the nutrient values of foods donated at public food drives (Zhu et al., 2014). In a drive of 965 total food items donated, 17.5% of the foods had low nutrient values and 16% were unusable. The majority of low nutrient foods were baked goods that are high in carbohydrate and sugar values compared to recommended daily value levels (Zhu et al., 2014). The researchers suggested a campaign to increase public knowledge of acceptable foods to donate, as the quality of foods donated can directly impact the diet quality and nutrient intake of people who utilize emergency food sources.

A barrier that plagues most social programs in the United States is limited resources. Because the majority of foods emergency food assistance programs receive are donated, there is limited internal control of what kinds of foods can be served to clients. Foods most easily accessed by food assistance programs are pasta, white breads, and rice because they are inexpensive for consumers and institutions and are the most commonly donated items (Koh et al., 2016). In an effort to improve dietary intake and promote healthier food choices, such as fruit and vegetable options over higher fat, processed carbohydrate options, food assistance programs have begun asking clients to try the healthier choices offered and have advertised them prominently in soup kitchen dining rooms (Koh et al., 2016). These strategies lead to increased

client intake of the healthier foods. If clients were initially resistant, phasing in healthier foods to a kitchen or pantry over time was also an effective strategy (Koh et al., 2016). Although resources can be limited in emergency food assistance programs, layout changes and social cues in a pantry or kitchen can have positive impacts on client dietary intake.

Changing role of emergency food sources

The purpose of emergency food sources is to act as a food safety net to individuals and households who are experiencing hunger. Food banks are central distribution centers to soup kitchens and pantries, which provide immediate food subsidies to the homeless and to families struggling financially at the end of the month or experiencing a time of economic hardship. In 2014, food banks fed over 46 million people in the U.S. (Weinfield et al., 2014). Federal assistance programs such as SNAP have been the primary programs assisting people struggling with long-term food insecurity (Bacon & Baker, 2017). Within the past 10 years, following the dramatic and continued rise of global food costs in 2008, reliance on emergency food sources as a long term solution to food insecurity has increased (Amadeo, 2018).

Increasingly, households that receive SNAP benefits also rely on food pantries and soup kitchens for meals. Over 3,000 households that used pantries were surveyed on their pantry use during initial enrollment in SNAP and 6 months into receiving SNAP benefits (Mabli & Worthington, 2017). After 6 months of receiving benefits, 76% of households continued to rely on pantries as a secondary source of food. This suggests SNAP benefits are too low to support most household's food needs over the course of a month (Mabli & Worthington, 2017). There is also evidence that SNAP does not help households meet the daily dietary guidelines. Of 661 Hispanic women aged 26-44 living in Texas, the majority did not meet the dietary guidelines, and SNAP recipients consumed higher amounts of sugar, desserts, and sugar sweetened

beverages in a day than non-SNAP recipients (Hilmers et al., 2014). Household SNAP participation is also linked to high BMI and waist circumference, which increases risk of metabolic syndrome and chronic health problems (Leung et al., 2012). The correlation of SNAP benefit participation with obesity may be caused by the diet choices of SNAP recipients, but the correlation with obesity is most likely due to a combination of diet choices and chronic food insecurity (Hilmers et al., 2014).

There have been small-scale trials of potential program revisions to SNAP in order to better meet the needs of food insecure households both financially and nutritionally. A study implemented a money-incentivizing program in a low-income community, which offered same-day coupons to half price fruits and vegetables. Coupons were redeemed 53% of the time, with eligible SNAP customers experiencing the greatest increase in fruit and vegetable spending with the coupons (Polacsek et al., 2017). Another similar study analyzed the effects of giving SNAP recipients a \$10 gift card for local produce if they spent \$10 on produce at a supermarket. This program increased vegetable expenditures and increased the variety of produce purchased, but the effects were moderate and not sustained without the financial incentive (Steele-Adjognon & Weatherspoon, 2017). Overall, possible incentive changes to the SNAP program to increase diet quality and food quantity have mixed results, but show potential to improve the health and food insecurity status of low income populations.

Conclusion

In 2016, food insecurity affected over 41 million Americans. The chronic struggle with food insecurity causes decreased diet quality, skipped meals due to lack of food, and reliance on federal assistance programs like SNAP and emergency food assistance programs to meet daily food needs. Food insecurity can lead to an increased risk of hypertension that can lead to

diabetes or cardiovascular disease that decreases health, quality of life and increases mortality. Limiting sodium intake and increasing access to foods high in micronutrients that directly lower blood pressure is an important strategy for controlling blood pressure and minimizing chronic disease risk. Access to these foods is often limited by low quality emergency assistance program donations and low value SNAP subsidies. With people experiencing food insecurity relying on emergency assistance programs now more than ever, there is an increased need for food donations that not only provide energy, but also provide nutrients necessary for good health. Hypertension is a common health ailment among people experiencing food insecurity, and increasing individual intake in micronutrients that decrease blood pressure is a key factor for controlling and preventing the disease and its complications. It is important for the public to look beyond food donation quantity and to care about donation quality in order to positively impact the health of the food insecure.

Methods

Research question

It was unknown what nutrients the donated food items from Food Recovery and the prepared items at Covenant Soup Kitchen provided to soup kitchen clients, and what the item's values were for the micronutrients that directly impact blood pressure. This paper determined the micronutrient content of the six most commonly donated food items by Food Recovery in the 2017 Fall semester delivered to Covenant Soup Kitchen and the micronutrient content of six typical food items prepared and served at the kitchen. Potassium, calcium and magnesium are micronutrients that can decrease blood pressure, and sodium is a micronutrient that can increase blood pressure (Reusser & McCarron, 1994). For this study, micronutrient content was defined as the milligrams of sodium, potassium, magnesium and calcium per serving of each food item. These data were used to calculate the ratio of the sodium to potassium value per serving of each food item. The FDA claims that diets high in potassium and low in sodium may reduce the risk of high blood pressure, and this statement was used to establish the meaning of the sodium/potassium ratios and to understand food item's potential effect on blood pressure (National Institutes of Health, 2018). This author hypothesized that Food Recovery food items had more potassium than sodium per serving, and therefore these items had more anti-hypertensive effects of potentially decreasing blood pressure than Covenant Soup Kitchen food items.

Research design and procedure

The design of the study was quantitative micronutrient content analysis of commonly donated food items by Food Recovery and typical food items served at lunchtime at Covenant Soup Kitchen. The collection sheets of food item and quantity, logged by Food Recovery

volunteers during the Fall 2017 semester, were used to determine the most donated food items. Food Recovery donated 700 total items and 34 different food item varieties that semester, and the items with the highest donation quantities were the items analyzed. The most donated items from Food Recovery were Side Salad (n=124), Husky Peanut Butter and Jelly (n=83), Ham and Cheese Sandwich on Piadina (n=82), Tuna on Wheat Roll (n=41), Side Salad with Grilled Chicken Strips (n=35) and Egg Salad on Kaiser Roll (n=31).

Covenant Soup Kitchen offered six different categories of food at each lunch: grain, protein (meat), cooked vegetable, green salad, fruit salad and soup. A representative recipe was chosen from each food category for nutrient analysis, as the food items changed daily because donations were sporadic and variable. Two days of sample menus from the Covenant Soup Kitchen from March 2018 were used to determine typically served food items. The items chosen for analysis were Tuscan Bean Soup, BBQ Chicken (protein category), Cooked Vegetable Medley, Mac and Cheese Casserole (grain category), Fresh Tossed Green Salad, and Fresh Fruit Salad.

NutriBase (Cybersoft, Phoenix, Arizona) was used for nutrient analysis. To ensure accuracy of nutrient content, the ingredients were chosen from the USDA foods category on NutriBase. UConn Dining Services prepared the food items donated by Food Recovery using standardized recipes, and these recipes were input into NutriBase for each item. Weight was the unit of measurement for the ingredients in the standardized recipes, and was the unit used for nutrient analysis. The food items were pre-portioned when delivered to the soup kitchen, and serving size was determined by the weight of the food item.

The recipes available and used for analysis for the Covenant Soup Kitchen food items were Mac and Cheese Casserole and Tuscan Bean Soup. Fresh Tossed Green Salad, Fresh Fruit

Salad, BBQ Chicken and Cooked Vegetable Medley food items had known ingredients, but no ingredient quantities, so estimates of ingredient quantities were used. Volume was the unit of ingredient measurement and unit of input into NutriBase for the available recipes and estimated recipes. The serving size for each food item was as follows: 5 fl. oz. Tuscan Bean Soup, 1/2 lb. BBQ Chicken, 1 cup Fresh Tossed Green Salad, 1/2 cup Fresh Fruit Salad, 1/2 cup Cooked Vegetable Medley, and 2/3 cup Mac and Cheese Casserole. The volume of the serving scoopers and soup bowls used at the kitchen determined the portion sizes of the food items.

For each food item provided by Food Recovery and Covenant Soup Kitchen, a comprehensive nutrient report was generated of the micronutrient content for one serving size. These values were used to calculate a ratio of milligrams of sodium to milligrams of potassium per serving of food item to determine which micronutrient was more abundant, and therefore able to influence blood pressure. The ratio method was also used in a study that determined the dietary sodium and potassium intake levels of people experiencing food insecurity (Nothwehr, 2014). If the sodium/potassium ratio was greater than 1, then more sodium was in the food item than potassium. If the sodium/potassium ratio was less than 1, then more potassium was in the food item than sodium. Calcium and magnesium values of the food items were also compared because of the anti-hypertensive effects of these nutrients, and the foods with the largest and lowest values were noted.

Results

Of all the food items analyzed, Fresh Fruit Salad had the lowest sodium/potassium ratio of 0.04, and Ham and Cheese Sandwich on Piadina had the largest sodium/potassium ratio of 26.53 (Table 1). Of the Food Recovery items, the Side Salad (0.27) had a sodium/potassium ratio less than 1, while the other items Egg Salad on a Kaiser Roll (4.60), Side Salad with Grilled Chicken Strips (3.84), Tuna on Wheat Roll (6.36), Husky Peanut Butter and Jelly (1.22), and Ham and Cheese Sandwich on Piadina (26.53) had sodium/potassium ratios greater than 1 (Table 1). Of the Covenant Soup Kitchen items, the Cooked Vegetable Medley (0.57), Fresh Tossed Green Salad (0.28), and Fresh Fruit Salad (0.04) had sodium/potassium ratios less than 1, while the other items Tuscan Bean Soup (1.99), Mac and Cheese Casserole (2.84), and BBQ Chicken (1.23) had sodium/potassium ratios greater than 1 (Table 1).

Food Recovery	
Food Item	Sodium/Potassium Ratio
Side Salad	0.27
Ham and Cheese Sandwich on Piadina	26.53
Husky Peanut Butter and Jelly	1.22
Tuna on a Wheat Roll	6.36
Side Salad with Grilled Chicken Strips	3.84
Egg Salad on Kaiser Roll	4.60
Covenant Soup Kitchen	
Food Item	Sodium/Potassium Ratio
Fresh Fruit Salad	0.04
Fresh Tossed Green Salad	0.28
BBQ Chicken Breast	1.23
Mac and Cheese Casserole	2.84
Tuscan Bean Soup	1.99
Cooked Vegetable Medley	0.57

Table 1: Sodium (mg) to Potassium (mg) ratio for Food Recovery food items and Covenant Soup Kitchen food items

Covenant Soup Kitchen offered 3 food items with sodium/potassium ratios less than 1 while Food Recovery offered 1 food item with a sodium/potassium ratio less than 1 (Chart 1, Chart 2). Ham and Cheese Sandwich on Piadina had the largest sodium value of all the food items at 1937 mg per serving, and Fresh Fruit Salad had the lowest sodium value at 7 mg per serving. BBQ Chicken breast had the largest potassium value at 1010 mg per serving, and Side Salad had the lowest potassium value at 67 mg per serving (Table 2). Mac and Cheese Casserole had the largest calcium value at 248 mg per serving, and Fresh Fruit Salad had the lowest calcium value at 15 mg per serving (Table 2). Husky Peanut Butter and Jelly had the largest magnesium value at 102 mg per serving, and Fresh Tossed Green Salad and Side Salad were tied with the lowest magnesium value at 5 mg per serving each (Table 2).

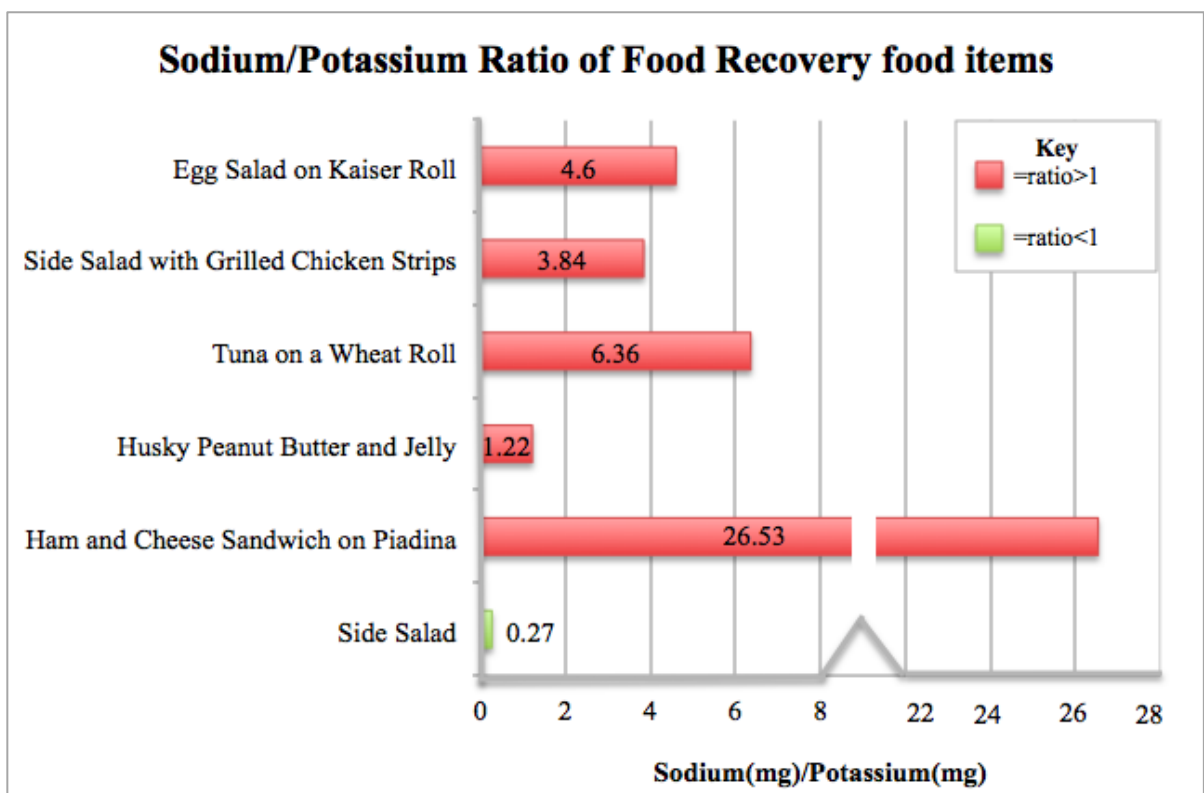


Chart 1: Sodium/Potassium Ratio of Food Recovery food items

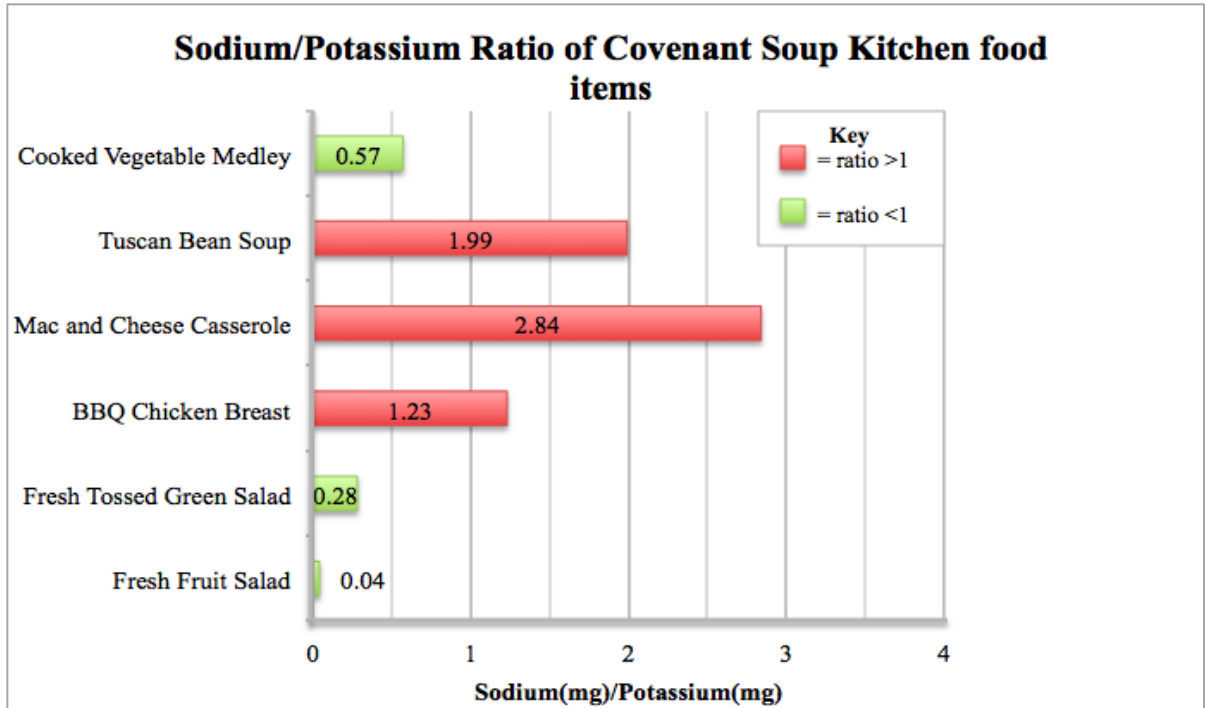


Chart 2: Sodium/Potassium Ratio of Covenant Soup Kitchen food items

Food Recovery					
Food Item	Serving Size	Sodium (mg)	Potassium (mg)	Calcium (mg)	Magnesium (mg)
Side Salad	7.5 oz.	18	67	73	5
Ham and Cheese Sandwich on Piadina	1 sandwich	1937	73	167	9
Husky Peanut Butter and Jelly	1 sandwich	570	466	53	102
Tuna on a Wheat Roll	1 sandwich	763	120	52	7
Side Salad with Grilled Chicken Strips	7.1 oz.	357	93	213	12
Egg Salad on Kaiser Roll	1 sandwich	580	126	103	10
Covenant Soup Kitchen					
Food Item	Serving Size	Sodium (mg)	Potassium (mg)	Calcium (mg)	Magnesium (mg)
Fresh Fruit Salad	1/2 cup	7	178	15	10
Fresh Tossed Green Salad	1 cup	29	104	28	5
BBQ Chicken Breast	1/2 lb.	1240	1010	95	85
Mac and Cheese Casserole	6 oz.	315	111	248	11
Tuscan Bean Soup	5 fl. oz.	290	146	17	6
Cooked Vegetable Medley	1/2 cup	95	166	41	8

Table 2: Micronutrient content values for Food Recovery food items and Covenant Soup Kitchen food items

Below, Figure 1 is the comprehensive nutrition report of Fresh Tossed Green Salad, an item prepared by Covenant Soup Kitchen. The comprehensive nutrition reports stated the micronutrient content of each food item, which were used to create Table 2. Figure 2 is an example of the standardized recipes used by UConn Dining Services to prepare the foods sold at the UC Cafés and donated by Food Recovery, and is the recipe for Husky Peanut Butter and Jelly. Figure 3 is an example of a written recipe used by Covenant Soup Kitchen, and is the recipe for Mac and Cheese Casserole.

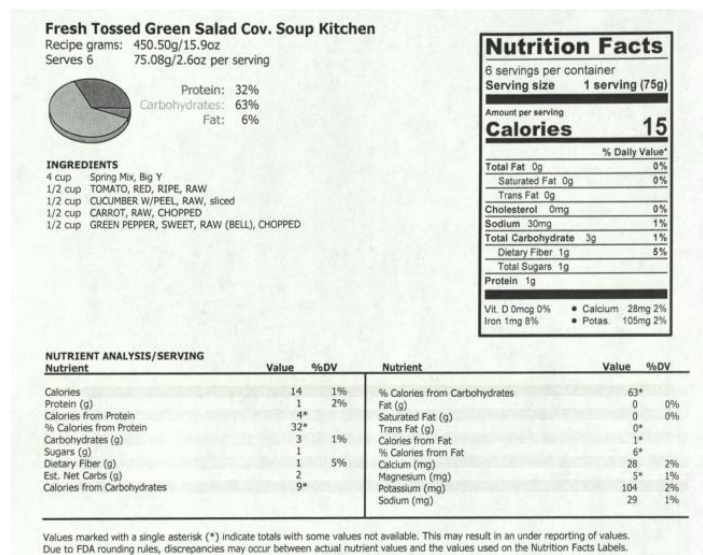


Figure 1: Example of NutriBase comprehensive nutrient report

Ingredients

Item	Name	Amount	Unit	Vary	Yield	Process	NDB Info
811033	UCONN WHITE BREAD	1.0000	LOAF	Yes	1.0000		
0577	PEANUT BUTTER SMOOTH PJR	1.0000	LB	Yes	1.0000		1 U00577 (100)
2503	JELLY GRAPE PJR	0.7500	LB	Yes	1.0000		1 U02503 (100)

Method of Preparation

CCP - Wash hands and change gloves thru the duration of the recipe.

- 1.Place bread on work surface.
- 2.Spread 2oz (round red scoop) peanut butter, on slice of bread.
- 3.Spread 1.5oz (level purple scoop) of jelly over other slice of bread.
- 4.close up sandwich and wrap.

Figure 2: Standardized recipe for Husky Peanut Butter and Jelly, a UC Café food item prepared by UConn Dining Services

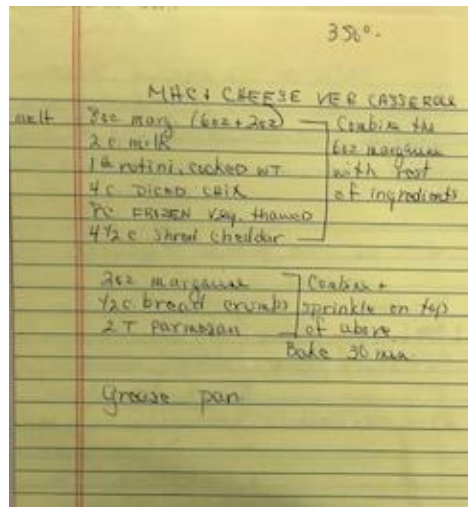


Figure 3: Recipe for Mac and Cheese Casserole from Covenant Soup Kitchen

Discussion

Major findings

These data show Covenant Soup Kitchen offered more food items that had more potassium than sodium per serving than Food Recovery items, and disproves the author's hypothesis. Covenant Soup Kitchen offered 3 items with a sodium/potassium ratio less than 1, where Food Recovery offered 5 items with a sodium/potassium ratio greater than 1. Covenant Soup Kitchen prepared Fresh Fruit Salad, the food item with the lowest ratio, where Food Recovery offered Ham and Cheese Sandwich on Piadina, the food item with the highest ratio. These numbers indicate that the majority of Food Recovery's donations had the potential to negatively impact blood pressure. Of the total food items analyzed from Food Recovery and Covenant Soup Kitchen, 33% of food items had a sodium/potassium ratio less than 1, and 66% had a sodium/potassium ratio greater than 1.

Importance

This study analyzed the quantity of micronutrients able to impact blood pressure and the ratio of sodium to potassium values in foods donated by Food Recovery and prepared by Covenant Soup Kitchen. The sodium/potassium ratio was used to predict if food items, consumed in isolation, could have the potential to decrease or increase blood pressure (Nothwehr, 2014). The micronutrient content analysis of the food items from Food Recovery highlighted the nutritional impact of the program, specifically related to blood pressure, which was previously unknown. Although the nutrient analysis was not comprehensive in understanding the complete nutritional impact of the program, focusing on potential anti-hypertensive or hypertensive effects of the foods is a useful lens for implying the potential impact that donated food items can have on the health of people experiencing food insecurity. This is important because adults experiencing food insecurity have higher rates of hypertension and are 22% more likely to develop hypertension than food secure adults (Seligman et. al, 2010). There is no doubt that the Food Recovery items supplied energy and options for clients, but 5 of the 6 food items provided and analyzed had a ratio greater than 1, indicating the foods that could have a negative impact on blood pressure. Even though the majority of food items donated by Food Recovery may have increased blood pressure, the program also donated 1 item that had more potassium than sodium, which may have decreased blood pressure.

Half of Covenant Soup Kitchen's food items had a sodium/potassium ratio less than 1, and therefore had the potential to decrease blood pressure and benefit clients. Covenant Soup Kitchen also offered six different categories of foods to choose from: soup, protein, cooked vegetable, grain, green salad and fruit salad. These categories displayed the wide variety of food sources that provided clients micronutrients, and two food categories offered only had produce

ingredients. Fresh Fruit Salad offered four different fruits and Fresh Tossed Green Salad offered five different vegetables, and the produce within the salads varied seasonally. These food items were excellent sources of produce, and provided variety to clients, which is an important component of a well balanced diet. Fresh Fruit Salad had the lowest ratio of all the foods surveyed, which is not surprising because the only ingredients were sliced fruits that were low in sodium and rich in micronutrients (USDA, 2016). Fresh Fruit Salad offered two different sources of melon, honeydew and cantaloupe, which are nutritionally dense in potassium. The high potassium levels per serving for honeydew melon and cantaloupe caused the Fresh Fruit Salad to have a micronutrient ratio much less than 1.

Covenant Soup Kitchen offered the item with the largest calcium value per serving, Mac and Cheese Casserole (248 mg), and Food Recovery provided the item with the largest magnesium value per serving, Husky Peanut Butter and Jelly (102 mg). Magnesium effects blood pressure by promoting vasodilation, and calcium helps regulate vasodilation and vasoconstriction for blood pressure homeostasis ("Key minerals to help control blood pressure," 2014). The foods provided with large calcium or magnesium values may have additional anti-hypertensive effects beyond sodium/potassium ratio because of the additional micronutrients. Sodium and potassium have a direct relationship in the body, where increased potassium consumption will increase sodium excretion in the body and mitigate sodium's blood pressure effects. Calcium and magnesium do not have this relationship with sodium and will play a lesser role in the maintenance of blood pressure homeostasis, but will still provide anti-hypertensive benefits ("Potassium and sodium out of balance," 2009).

Of the total food items offered by the Covenant Soup Kitchen and provided by Food Recovery, 4 items had ratios less than 1. The two organizations worked together to provide good

tasting, quality food, and necessary energy to people experiencing food insecurity in Willimantic. With no previous intention of positively impacting health beyond providing energy, 33% of the foods available to the clients had more potassium, which directly decreases blood pressure, than sodium. It is important to remember that isolated food items were analyzed in this study, and clients would eat multiple food items at once during a meal. To understand the specific micronutrient intake of a client, individual meal analysis would need to be done of all the foods consumed. The micronutrient information of the food items offered has the potential to increase hypertension awareness and education within the kitchen. Promoting foods that have a sodium/potassium ratio less than 1 could increase client awareness of foods that could help manage hypertension, and could influence individual food choices.

Study's limitations

This nutrient analysis had many limitations. The food items donated by Food Recovery were standardized recipes by UConn Dining Services, whereas the majority of the food items analyzed from Covenant Soup Kitchen had known ingredients but no standardized recipe or ingredient quantity. Therefore, the ingredients input into NutriBase were estimated for the Covenant Soup Kitchen items, and consequently the micronutrient content and ratio for these food items was estimated. The ingredients for Fresh Fruit Salad and Fresh Tossed Green Salad also varied seasonally and day to day, and the variety of produce ingredients in these food items would cause micronutrient variations. The ingredients for the other food items prepared at Covenant Soup Kitchen were also variable, and a different brand or variation of an ingredient used could change the micronutrient content and ratio. For example, if low sodium vegetable broth was donated and used in the Tuscan Bean Soup instead of full sodium vegetable broth, the

sodium content of one serving of soup would be drastically changed from the original nutrient analysis, as would the micronutrient ratio.

This study also did not analyze the effect of individual food intake differences on micronutrient intake because of client choice and consumption. Covenant Soup Kitchen did not season any of the foods they prepared to allow clients to flavor foods how they pleased. The kitchen offered salt and pepper, ketchup, various salad dressings, sugar, barbeque sauce, mayonnaise and adobo seasoning for clients to add to any food items. Addition of these condiments to the prepared and offered food items would influence individual client micronutrient intake, especially if salt was added. Condiment addition could change a food's ratio from less than 1 to greater than 1, and could change the food item's potential impact on blood pressure.

Clients at the kitchen were also free to choose what food items they wanted to consume that were offered by the kitchen and by Food Recovery. Choice drastically affected individual micronutrient intake, because different food combinations would influence total micronutrient intake and impact blood pressure. For example, some clients may have chosen foods with a large sodium/potassium ratio and added salt, while other clients may have only eaten the green and fruit salads without dressing. This study also excluded calorie analysis of the donated and prepared food items. Obesity can increase risk of hypertension, and total calorie intake during a meal could affect an individual's risk of becoming overweight or obese. In the case of an overweight or obese client, calorie control for weight loss may have a more immediate and lasting effect on hypertensive status than micronutrient intake (Grundy, 2004). Through the nutrient analysis done in this study, it was impossible to know the individual micronutrient intake or calorie intake of clients. This offers potential for further nutrition education within the

kitchen, through promotion of foods with more potassium than sodium, or education about the impact of added condiments on sodium intake. Through this promotion and education, the kitchen could work to influence client choice in order to promote hypertension awareness and individual health management.

Lastly, Food Recovery had little control over what food items it could donate to the soup kitchen, and could not choose or change the micronutrient content of those foods. The items collected from UC Cafés were what was unsold, and presumably unwanted, by UConn students, staff and faculty. The program collected what items were available, and had no power to request certain items, had no purchasing power, and was constrained by the agenda of preventing food waste. For Food Recovery to donate foods that only had ratios less than 1, UConn Dining Services would have had to provide foods to the UC Cafes that only had ratios less than 1. There is a delicate balance between reducing food waste and providing quality nutrition to people experiencing food insecurity that Food Recovery was striving for everyday. The program's mission was not to improve the micronutrient intake of soup kitchen clients, but the micronutrient content of donated items is now an important factor to consider in order for future food donations from the program to positively impact client health.

Suggestions for further research

This analysis was straightforward and had various limitations, leading to further questions to completely understand the nutritional impact of the Food Recovery program and Covenant Soup Kitchen and how it relates to the health of the kitchen's clients. Further research could do a complete nutrient analysis of the food items donated and prepared by the programs, in order to better understand what nutrients are offered. For example, this analysis could study sugar, saturated fat, or fiber content. All of these nutrients influence health, and a high intake of

sugar or saturated fat and a low intake of fiber over time could contribute to increased risk of chronic disease in clients ("Healthy Eating Plate & Healthy Eating Pyramid," 2011). Further research would also be limited by the variability of food items offered on a given day, and researchers would have to analyze the most available items, or items from sample menus on randomly selected days. This research could analyze all of the foods offered similar to this study, or analyze individual nutrient intake to get a more accurate portrayal of what clients are consuming.

Another avenue of future research would be to measure blood pressure and hypertensive status of soup kitchen clients, while tracking their micronutrient intake at the kitchen over a period of time. This method could be used to measure a stronger correlation between the sodium/potassium ratios in foods and blood pressure. It could also be used to understand if hypertension is prevalent within the Willimantic food insecure population, and if further education, medical attention or nutrition promotion is needed. This research would be a direct way of measuring the impact of foods on blood pressure. A major limitation of this study is it would require IRB approval to measure the blood pressure of soup kitchen clients, as they are a vulnerable population. It would also be difficult to control for consumption of other foods, weight, smoking, and alcohol consumption by individuals, all of which can influence blood pressure. Lastly, it would be time consuming to calculate the individual micronutrient intake of a sample size of clients over a time period long enough for meaningful results.

A logical next step after finishing this analysis would be to inform Covenant Soup Kitchen of the food items with sodium/potassium ratios less than 1, and to make clients aware of these foods. This nutrient information is valuable, and could be used to increase hypertension awareness and nutrition education in the soup kitchen. Further studies could also analyze what

method of nutrition education was the most influential for clients, such as pamphlets, posters, or lecturing. Researchers could have three different groups of clients that receive education in three different ways, and give an assessment after each method of education delivery. The group with the highest average score would have retained the most information, and that mode of education would be the most effective for client nutrition information retention. Analyzing if nutrition education could influence foods chosen would be insightful as to how education could increase client micronutrient intake, not only for anti-hypertensive purposes, but to improve overall health.

Conclusion

With the majority of food items from Food Recovery having more sodium than potassium, it could be argued that continuing the program is not beneficial to the hypertensive status of the food insecure in Willimantic. The different factors of the program and the needs of the people experiencing food insecurity need to be examined to fully understand Food Recovery's impact on the community. Food Recovery was started to decrease food waste, and the program was successful in preventing 700 food items from being thrown away in the Fall 2017 semester. Food Recovery also provided clients with prepackaged to-go items, choice, and energy. Options for clients are important to accommodate dietary restrictions, and also to increase client self-efficacy with food choice. Because the food items are pre-packaged, they can be easily transported by clients and can provide an additional meal during the day. Energy is an important factor for the clients, who often decrease portion sizes or skip meals because of lack of access or efforts to make food last (Jensen-Coleman, 2015). The quality of food items beyond micronutrient content is also important, such as fiber content or unsaturated fat content, for health and livelihood.

This study did not completely analyze the nutrition of the food items, so the overall nutritional impact of items provided by Food Recovery is unknown. Overall, Food Recovery's mission was not to promote health, but to decrease waste and secure food for Covenant Soup Kitchen to provide to their clients. Food Recovery was a consistent source of donations to the kitchen, and helped to prevent the kitchen from being limited in how many people could be served due to the variability of other donation sources. The program offered items that provided convenience and choice while reducing food waste, and the items may have provided nutritional benefits beyond the micronutrient parameters of this study. Therefore, the program should be continued for the positive benefits it does offer, but the majority of foods offered did not improve micronutrient intake or potentially decrease blood pressure.

The central question of this study was to understand if foods offered at a soup kitchen had the potential to increase or decrease blood pressure, and could be consumed for potential hypertension management or prevention. Often, the quantity of food donated is the focus of donors and kitchens in order to feed the large volume of clients at soup kitchens every day. Individuals, universities and supermarkets often donate what is "left over," like canned items that have not been used or items that went unsold. As mentioned in the literature review, a study found that 16% of foods donated in drives are unusable, and 17.5% are high sources of fat and calories (Zhu et al., 2014). Donated foods are often close to their expiration date and are donated in order to reduce waste, and this may hurt soup kitchen's efforts to provide enough energy and nutrients to clients. The act of donation is also seen as charity, and the lack of focus or regard for the nutritional value of donated foods is socially acceptable (Campbell et al., 2015).

People experiencing food insecurity are at higher risk of chronic, diet sensitive diseases like hypertension than people who are food secure, and consuming quality, nutritionally dense

foods could positively influence their health. Soup kitchens are a major source of nutrients for people experiencing food insecurity, and if donations are not nutritionally rich or useable, they will affect individual nutrition status and energy balance. Increased public awareness of the health inequities associated with food insecurity, along with increased education about what foods are healthy and nutrient rich could increase the nutritional quality of foods donated to soup kitchens, and could improve the health of people experiencing food insecurity.

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