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Food Intake Patterns and Plate Waste Among Community Meal Center Guests Show Room for Improvement

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Food-insecure individuals often consume nutritionally inadequate diets. Using a weighted plate-waste analysis, we examined whether adult guests of 2 independently operated meal centers were served and consumed FDA recommended serving sizes (Reference Amount Customarily Consumed; RACC) of protein, starch, fruit, vegetables, and bread for the dinner meal. In both centers, guests were served and consumed more than 100% of RACC for protein. Regardless of amount served and independent of whether guests took seconds, consumption of fruit and vegetables was less than RACC. Larger servings of vegetables, but not of protein or starch, resulted in more plate waste. Guest surveys and informal interviews indicated that amounts served and preparation methods influenced food consumption and waste patterns. In order to provide adequate nutrition and to reduce food waste, meal centers may need to further examine food preparation and serving practices.

KEYWORDS food intake, weighted plate waste, community meal center, RACC

INTRODUCTION

Nearly 14% of adult Californians are food insecure.[1,2] This figure mirrors the national average, where an estimated 14.5% of households meet this classification.[3] Soup kitchens, or community meal centers, regularly serve food-insecure and homeless individuals.[4-10] These meal centers play an important role in filling the food gap. However, studies have indicated that meals provided at these sites are often nutritionally inadequate, and low in nutrient-dense fruits and vegetables.[4,6-10] The co-morbidity of food insecurity and obesity[11-16] calls for a closer examination of the amounts and types of food served and consumed at these sites. If the meal centers do not, in fact, provide appropriate serving sizes of nutrient-dense foods (such as lean protein, fruits, and vegetables), or if the food served is not consumed because it is unpalatable, cannot be chewed, or is culturally inappropriate, meal-center guests may fail to receive adequate nutrition. In addition, if large servings of starches (grains) and breads are served and consumed, guests may receive adequate calories at the expense of more nutritious foods.

This research examined consumption patterns across food groups and genders at 2 independently operated community meal centers in a large Northern California city, and secondarily examined, using guest surveys and on-site interviews, possible reasons for food consumption patterns and plate waste.

METHODS

Overview and Study Participants

In early Spring, 2011, a weighted plate-waste analysis and follow-up surveys and interviews took place at 2 meal centers operated by 2 non-profit organizations in San Jose, CA. Organization A operates one meal center (MC-A in this study), where dinner is cooked and served twice weekly.

In operation since 1981, MC-A serves over 200,000 meals a year, primarily to men. Organization B cooks and serves meals Monday through Friday to nearly 1,000 guests a week in their 3 centers throughout the city. One of these 3 meal centers serves meals primarily to homeless men, one serves primarily to adults and seniors (Meal Center B [MC-B] in this study), and one serves primarily to single mothers with children.

The San Jose State University Institutional Review Board approved the research protocol. After completing 3 days of onsite training, student research assistants, supervised by the authors, helped collect plate-waste data from convenience samples of adult male meal recipients at MC-A, and of male and female meal recipients at MC-B. Data were collected once a week at each site over the same 3-week period. Differences in gender, types and amount of food served at each site, and in methods of food distribution (e.g., method of serving second helpings), allowed for comparisons of guests' food intake and waste at these 2 sites.

At both MC-A and MC-B, guests received pre-portioned amounts of 5 meal components: protein (typically chicken, beef, or turkey); starch (such as potatoes, rice, or pasta); fruit (often fresh fruit salad, apple or orange slices, or canned); vegetables (cooked fresh, or canned); and bread. Salad was served daily only at MC-A. Both MC-A and MC-B served food on identical 6-compartment polycarbonate type "A" lunch trays. Soup was an optional item in both centers, and soup intake and waste was not measured. Although both sites allowed guests to take second helpings, guests at MC-A used a second Styrofoam tray for seconds; at MC-B, guests who took seconds used the same tray that held their first helpings. At MC-A, consumption and waste data for males included only first helpings, while at MC-B, such data included both first and second helpings. To keep track of gender and individuals who took seconds, prior to each meal all trays at MC-B were numerically labeled with a piece of removable tape. Two research assistants observed guests as they exited the tray line and kept track of gender and of persons taking seconds.

Calculation of Amount Consumed and Wasted

For both sites, a selective aggregated weighted-plate-waste method[17,18] was used to determine food consumption patterns for the 5 meal components: protein, starch, fruit, vegetables, and bread. Salad was served and measured only at MC-A. First, on each day of the study, the average serving size of each meal component served to guests was determined by weighing to the nearest ounce (using a Salter Max View scale [Oakbrook, IL]) individual food components from a "standard" tray (which represented a full tray provided to each guest).

After the meal, trained research assistants collected trays from each guest, and separated each uneaten food item into labeled waste buckets. When mixed dishes were served, care was taken to separate individual meal components (e.g., meat from potatoes and vegetables from stews). In MC-A, only one set of buckets was needed to collect waste (for males); in MC-B, there was one set of buckets for males and another set for females. After all guests had completed dinner, buckets were weighed to the nearest ounce. Average per person waste for each meal component was calculated from the total weight of each wasted food item divided by the total number of trays collected.

The total amount of each meal component consumed at each meal center was calculated by subtracting the total amount of plate waste (for each meal component) from the total amount of each meal component served. For MC-A (where only first helpings were examined), the total amount of each meal component served was defined as the average amount served per tray (in

ounces) multiplied by the number of people served. For MC-B, the total amount of each meal component served also included the amount served for second helpings.

The average amount of each meal component consumed was calculated separately for each meal center (since MC-B included individuals who took second helpings), and separately for gender at MC-B. Average per person consumption of each meal component was compared to the FDA's Reference Amount Customarily Consumed (RACC) serving sizes for each meal component.[19,20]

Guest Surveys and Interviews

A guest survey and informal interviews were conducted over the course of 3 days at each site in the weeks immediately following the plate-waste analysis, after guests had provided written informed consent. Respondents provided their gender and age, and whether they had eaten at the meal center before. One multi-part question sought to determine reasons for guests not consuming or not finishing particular meal components served, and asked guests to put a check mark for each reason a particular meal component (e.g., protein, starch, vegetable) was not eaten or only partially consumed. Response choices included "I was not hungry for it," "Too much was served and I could not finish it all," "I tried it but I didn't like the taste," "Some of the food was too hot (or too cold)," "I thought it was not cooked well," "The food tasted too sweet (or too salty or too greasy) to me," "I did not know what it was," "I could not chew it," and "I wanted to take it with me to eat later."

Data Analysis

Means and standard deviations were calculated for all measures of food intake and plate waste using Excel 2007 (Microsoft Company, Redmond, WA). The Mann-Whitney U test was used to determine differences for the same measures between males at MC-A and MC-B, and between males and females at MC-B using SPSS for Mac version 20 (IBM Corporation, Armonk New York). Survey responses were coded to allow for determination of response frequency.

RESULTS

Food Consumption Patterns at Each Site

A total of 474 trays were collected over 3 days at MC-A. All guests were males, and measured intake included only the "first pass" through the line. MC-A served over 100% of the RACC for protein, starch and vegetables. Without considering second helpings, guests consumed, on average, over 100% of the RACC for protein, almost 100% of the RACC for starch, 62% of the RACC for vegetables, and 28% of the RACC for salad. Guests were served almost 95% of the RACC for bread and consumed 63% of the RACC. For fruit, guests were served 2/3 of the RACC and consumed, on average, 42% (Table 1).

TABLE 1. Average Food Consumption Relative to the Reference Amount Customarily Consumed (RACC), and Average Amount of Food Wasted, by Meal Center and Gender[a]

	Protein	Starch	Fruits	Vegetables[b]	Salad[b]	Bread
RACC (oz.)	3.0	5.0	5.0	3.7 ± 1.6	4.2 ± 1.6	1.8
Meal Center A (males) (n=474)						
Average amount served/tray (oz.)	4.1 ± 2.6	5.3 ± 2.9	3.3 ± 2.0	3.9 ± 2.1	2.2 ± 1.2	1.7 ± 1.0
% RACC served/tray	138.0 ± 0.7	106.7 ± 0.3	66.7 ± 0.3	105.9 ± 0.3	51.6 ± 0.1	94.9 ± 0.3
Consumption per person (oz)	4.0 ± 1.9	4.9 ± 1.2	2.1 ± 1.3	2.3 ± 0.8	1.2 ± 0.8	1.1 ± 0.9
% RACC consumed	132.4 ± 0.6	97.7 ± 0.2	42.2 ± 0.3	62.1 ± 0.2	28.4 ± 0.2	62.5 ± 0.5
Average per person waste (oz)	0.2 ± 0.1	0.4 ± 0.3	1.2 ± 0.6	1.6 ± 0.9	1.0 ± 0.6	0.6 ± 0.4
Meal Center B (males and females)						
Average amount served/tray (oz.)	3.3 ± 0.8	4.3 ± 1.3	3.3 ± 0.5	2.8 ± 1.1	N/A	1.9 ± 0.9
% RACC served/tray	110.1 ± 0.3	86.7 ± 0.3	66.7 ± 0.1	75.5 ± 0.3	N/A	106.5 ± 0.5
Males (n=215)						
Consumption per person (oz)	4.1 ± 1.4	4.9 ± 1.0	3.7 ± 0.8	3.2 ± 2.3		2.4 ± 1.7
% RACC consumed	135.9 ± 0.5	98.1 ± 0.2	73.9 ± 0.2	86.0 ± 0.6		132.9 ± 0.9
Waste per person (oz)	0.1 ± 0.1	0.4 ± 0.2	0.5 ± 0.3	0.5 ± 0.5		0.1 ± 0.1
Females (n=108)						
Consumption per person (oz)	3.8 ± 1.2	4.5 ± 1.5	3.4 ± 0.9	3.0 ± 2.2		1.9 ± 1.0
% RACC consumed	128.5 ± 0.4	90.9 ± 0.3	68.1 ± 0.2	80.1 ± 0.6		103.1 ± 0.5
Waste per person waste (oz)	0.3 ± 0.1	0.7 ± 0.6	0.7 ± 0.2	0.7 ± 0.3		0.6 ± 0.7

[a] Data are provided as means ± SD.

[b] For vegetable and salad, RACC was calculated as the average of the different vegetables and salads served.

At MC-B, 323 trays were collected over 3 days. Two-thirds of MC-B guests were males. An average of 22 men and 11 women took seconds at each meal. For those taking seconds, 86% took each meal component offered. For second helpings, fruit was chosen less often than other items. MC-B served over 100% of the RACC for protein and bread. Considering second helpings, males and females consumed, on average, more than 100% of the RACC for protein and bread. MC-B served between 66 and 87% of the RACC for fruit, vegetables and starch. Considering second helpings, average amounts consumed were higher than the amounts served for each of these items. In males served at MC-B, average amounts consumed approached the RACC for starch. In both males and females served at MC-B, the average amount consumed was lower than the RACC for fruit and vegetables. Men, as compared to women, consumed 8% more protein, 7% more starch, and 6% more fruit and vegetables, but their average intakes were not statistically different.

Food Consumption Patterns Between Sites and Food Waste

Average per person consumption for males was almost identical for protein and starch at MC-A and MC-B. Although males at MC-B compared to males at MC-A consumed higher percentages of the RACC for fruit, vegetables, and bread, these differences were not statistically significant. Guests at both centers reflected relatively high total consumption rates for protein and starch with little waste in each category. A higher proportion of guests from MC-B as compared to MC-A consumed all of their fruit, vegetables, and bread (Table 2).

TABLE 2. Percent of Meal Center Guests at Each Site Who Consumed 100% of the Reference Amount Customarily Consumed for Specified Meal Components

Meal Center	Protein	Starch	Vegetable	Fruit	Bread
MC-A (n=474)	90	81	40	37	57
MC-B (n=323)	88	84	75	79	91

Overall, guests at MC-A, as compared to MC-B, were served, consumed and wasted more food. Waste at MC-A, where guests discarded, on average, 45% of salad, 41% of vegetables, 36% of fruit, and 35% of bread served, was 68% higher than at MC-B. At MC-B, (where salad was not served), women, as compared to men, discarded more bread (31% vs. 5%), vegetables (25% vs. 18%), fruit (21% vs. 15%), starch (16% vs. 9%), and protein (9% vs. 3%). Among those who took seconds, 12% discarded some vegetables, 10% discarded some protein, and 9% discarded some fruit.

Surveys and Interviews

A total of 121 guests aged 22 to 83 years completed surveys. The majority of respondents were regular meal center attendees; 67.8% (n = 82) were males. The top reasons given for not consuming various types of food were “I was not hungry for it” (12% [n = 14] and 9% [n = 11] of respondents provided this response for vegetables and starch, respectively); “I did not like the taste” (9% [n = 11] provided this response for vegetables); and “Too much was served” (9% [n = 11] provided this response for starch.) Fewer than 8% (n = 10) of respondents provided

responses to all other questions. Personal interviews revealed that some guests chose to take protein and starches with them to consume later, and that they did not think that certain vegetables were cooked well.

DISCUSSION

This study sheds light on two important issues facing meal centers and their clients: food consumption patterns and plate waste. Food consumption patters influence the nutritional status of food-insecure individuals. Wasted food can mean that guests fail to consume healthful foods that are served, fewer clients may be provided with food, and more food may enter the municipal waste stream.

The current study supports earlier research which indicated that meal center guests may be served and may consume adequate amounts of protein and starch[4,5] yet may fail to be served and/or consume adequate amounts of nutrient dense fruits and vegetables.[4,5,6] This study is the first to examine how various factors contribute to low intake of healthful fruits and vegetables among food-insecure clients at community meal centers. In this study, even though MC-A guests were served the RACC for vegetables and 52% of the RACC for salad, the reason MC-A guests failed to consume adequate amounts of vegetables was because guests discarded over 40% of both vegetables and salad. Additional, MC-A's small fruit servings (only 2/3 of the RACC) and high discard rates (36%) meant fruit intake was also low at this site. At MC-B, despite smaller servings of vegetables as compared to MC-A (and no salad), overall vegetable consumption was higher. This was likely due to lower discard rates coupled with the positive contribution of second helpings, which increased overall food intake. However, consumption of vegetables at MC-B was still below the RACC.

The amounts of food consumed and wasted may be a function of serving size, the types and kinds of food served, food preparation methods and personal preferences. Plate-waste data from this study indicate lower waste levels for protein and starch, and higher waste for fruits and vegetables (especially at MC-A). This suggests that as guests "fill up" on protein, starches, and even bread, they may be less hungry for healthful fruits and vegetables. Differences in fruit and vegetable plate waste between MC-A and MC-B further suggests that food preparation methods and personal food preferences play an important role in what is consumed and wasted. It is possible that creative food preparation methods such as incorporating puréed vegetables may be necessary to increase vegetable intake and decrease its waste.[21] In addition, meal centers might consider serving smaller portions of food, especially starches.

Examination of food waste revealed that at MC-A, the average amount of total food waste in the dinner meal was 49 pounds/day (or about 2.5 tons/year), an amount that could feed 40+ people/day (based on the average weight of food provided), or 4,000 more people/year (based on MC-A serving dinner meals twice/week). In MC-B, the average waste of 7.8 pounds/day (for males) and 6.2 pounds/day (for females) translates into 1.8 tons/year of food waste, which (based on a 5-day/week serving schedule) could feed nearly 3,600 additional people/year. Although these amounts are significant, the discarded food does not represent a balanced diet, and the wasted food would have to be supplemented with protein and starch to provide guests with balanced meals. Additionally, wasted nutrient-dense fruits and vegetables are often more expensive than starches, and represent a financial "waste" for the meals centers, as well as a lost opportunity for guests to consume nutritious foods. Finally, food waste is a major contributor to the solid waste stream,[22] and, if sent to a landfill, can contribute to global warming.[23]

Limitations

The current study had 3 limitations. First, the method of food service and the inability to track those taking second helpings at MC-A prevented a one-to-one comparison between sites. However, the study design allowed the comparison of consumption patterns when guests took 1 versus 2 servings of food, and revealed that even with second helpings, guests at MC-B failed to consume the RACC for fruits and vegetables. The study design also revealed that larger serving sizes of vegetables at MC-A did not translate into higher vegetable consumption. This was unexpected since larger portions have been associated with increased food intake.[24,25] Although guests at MC-A, compared to MC-B, were served larger portions of protein, starch and vegetables, they consumed larger amounts only of protein and starch, not vegetables. The larger vegetable portions served at MC-A resulted in higher vegetable waste at that site. The effect of increasing portion size on intake should be examined for different types and kinds of foods, as the current data indicate that increasing portion size of vegetables might not have the same effect on consumption as increasing portion size of more palatable or preferred foods such as protein or starch.

A second limitation is that the survey instrument provided limited information regarding consumption patterns. Due to the study design, it was not possible to conduct surveys on the same days that food waste was collected. However, it appears unlikely that respondents who completed the survey were different from those who ate at these sites during the prior weeks, as respondents indicated that they were frequent meal-center guests. It is also possible that respondents did not want to look "ungrateful," and thus may have been hesitant to provide negative feedback about foods served. Despite the small sample size and these limitations, the responses collected provided reasonable explanations for food waste, and supported observations, specifically about vegetable waste. The third limitation is that a nutritional analysis of menu items, which would have provided a more complete picture of guests' nutritional intake, was not conducted.

CONCLUSION

While it is very difficult to achieve balanced nutrition among food-insecure individuals, community meal centers will continue to play an important role in bridging the meal gap in this vulnerable population. To maximize consumption of nutritious foods while minimizing food waste, meal centers must examine the types and kinds of foods served, the methods of food preparation, and the serving sizes of individual meal components. Meal centers should utilize guest feedback to influence methods of food preparation and service. Decreasing food waste is important in light of escalating food costs[26] and limited budgets.[27] Reducing food waste translates into feeding a greater number of individuals, and also results in reducing the municipal solid waste stream. Future research should more closely monitor consumption patterns and waste in connection with menu creation, methods of food preparation, and service at community meal centers to ultimately maximize nutrition and decrease risk for obesity among meal center guests.

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