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## **Changes in Food Choices after Tray Removal in a University Dining Hall**

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## **Changes in Food Choices after Tray Removal in a University Dining Hall**

### **Abstract**

If removing dining hall trays affects students' food choices was determined in a study involving dining hall patrons at a large public university in Southern US. In the study, two dining halls were selected as intervention and control dining hall. Dining hall trays were removed from the intervened dining hall for five consecutive days during regular university session. Tray waste data was collected from these dining halls in a quasi-experimental pre-post design. Difference-in-difference analysis was used to find the intervention effect on student food choice. A total of 3153 trays were observed (1564 in control and N= 1589 in intervention dining). Removal of trays resulted in a significant decrease in the total number of lunch plates, drink glasses, dishes with leftovers, and lunch plates with leftovers. Tray removal also resulted in a statistically, if not clinically significant increase in total number of salad bowls. Student food choices can be affected by removing trays from dining halls, specifically favoring less beverages, and without sacrificing salad consumption. Studies with more precise measures of tray waste are needed to understand the direct effect on energy and nutrient consumption.

Keywords: obesity, tray less dining, food behavior, low cost, college students

## **Introduction**

For many students, college represents the first time they have lived outside of their family homes, and are expected to make their own decisions regarding a number of daily activities, including dietary choices. Late adolescence, the time when most students enter college as freshmen, is marked by a sense of independence and autonomy, as well as a propensity toward stress, depression, and risk-taking behaviors, as one transitions from being viewed as a child to an adult.<sup>1</sup> Combining these psychological factors with a food environment that favors an “all-you-can-eat” mentality at most college dining halls may predispose college students to experience weight gain. In fact, the familiar concept of the “freshman 15” is borne out in studies, though the scientific study results on freshman students gaining 15 pounds in the first year of college is divided.<sup>2</sup>

Obesity in the United States is an ongoing public health concern. As of 2012, 34.9 percent of adults were obese and 68.5 percent were overweight or obese. In children ages 2 to 19, 16.9 percent were obese and 31.8 percent were either overweight or obese.<sup>3</sup> The costs of obesity in the United States have been estimated at \$147 billion in medical costs plus \$42.8 billion in productivity losses annually (2008 US\$).<sup>4</sup> Obesity, with some exceptions, can largely be attributed to positive energy balance.<sup>5</sup> Positive energy balance refers to the situation in which energy consumed is greater than energy expended, which can lead to weight gain. On average, diet quality in the United States is far from ideal and contributes to a net positive energy balance. Diet quality in the United States, although worse for lower socioeconomic groups, is poor across a range of educational and income strata, leading to widespread nutrition-related chronic disease.<sup>6</sup>

The university setting may therefore offer a unique opportunity to promote healthful dietary habits that lead to decreased weight gain in adulthood. As students learn to regulate their own food intake and make dietary choices in environments with numerous options, colleges and universities can facilitate healthful choices in a number of ways, including creating “built environments” in their cafeterias that allow for better portion control. Environmental or policy level changes that encourage young people to make better choices when dining outside of their homes may be one approach to preventing obesity.<sup>7</sup>

In this study, we tested the idea of removing trays from a university dining hall as a mechanism for improving dietary habits while decreasing food waste and encouraging sustainability. This study, conducted in conjunction with the University’s Office of Sustainability, relied on a two-group pre-post design to evaluate the effect of trays on student eating behavior, measured through number of measures on selection of lunch plates, salad bowls and dessert plates. We hypothesized that removing trays would decrease student consumption of beverages and side items.

## **Methods**

### ***Setting***

This study was conducted in spring 2015 within two dining halls at a public university in the Southern US with a total undergraduate student population of approximately 26,000 individuals. The two dining halls in this study serve 3,600 students each in on an average day during the semester. The University’s IRB determined that this study did not represent research involving human subjects, because the research took place in a public setting without the collection of any individually-identifying information.

### ***Study design and intervention***

This study was timed to coincide with the University's Office of Sustainability initiative to do a one week trial of dining without trays in one of five University dining halls. The initiative for tray less dining was intended to reduce food, water, and energy waste. We collected data on student's food behavior before and during tray removal.

The study design was a two group pre-, post- design with data collection from one control and one treatment dining hall during a baseline and an intervention period. The "intervention", or tray less, dining hall was selected by the administration because it had the most inconspicuously-located tray stack among the University dining halls. The students were not notified by the University in advance about the trays being removed. The control cafeteria was selected based on the control dining hall's similarity with the intervention dining hall with respect to size, operation hours, food being offered, layout, management team, and student body being served. The two dining halls are located on the same side of the campus and serve one student group.

Baseline data was collected in February 2015. Either a registered dietitian or a research assistant (dietary intern) was present in the dish return area of the control and intervention dining halls for one hour (11 am to 12 pm) during the lunchtime meal, for five consecutive weekdays prior to tray removal. The research assistants stood by the return dish rack to observe the trays as they were placed on the return rack, recorded outcome variables as described below. After one week, the trays were removed from the intervention cafeteria, and the process of data collection in both cafeterias was repeated, again at the lunchtime meal from 11 am to 12 pm, for five consecutive weekdays.

### ***Outcome variables***

The primary outcome variables for this study are: 1) total number of lunch plates, 2) total number of drink glasses, 3) total number of salad bowls, 4) total number of dessert plates, 5) number of dishes (lunch plates, salad bowls, dessert plates) with at least a quarter leftover, and 6) number of lunch plates with at least a quarter left over. The first four outcome variables were chosen to give us an understanding of how tray removal might alter food choices and drink consumption. The latter two outcome variables were chosen to give us an understanding of how tray removal might impact food waste. Data on these outcome variables were collected using a standardized tray waste record sheet developed for this study. The tray waste record sheet was a printed form with boxes to record the total number of lunch plates, drink glasses, salad bowls and dessert plates. The form also had options to record if there was a quarter of left over, half left over or not eaten at all for the lunch plates, salad bowls and dessert plates. The form was developed based on the Quarter Waste Method which is a validated method that could be used to generate an accurate measure of tray waste. It is a cost-effective, reliable and accurate visual method.<sup>8</sup> Data were collected by the research assistants using direct observation of the trays.

### ***Analysis***

The data was analyzed using SAS 9.3 (English, University of Georgia). Summary statistics across both dining halls for the pre and post intervention periods were calculated. Multivariate regression was used to estimate the impact of intervention on the six outcome variables. Each of the six outcome variables were regressed on a post intervention variable of interest, which is a binary variable (1 if post intervention and 0 otherwise), and dummies for days of the week. Days of the week fixed effects were used to capture differences in day that could theoretically affect food behavior patterns, such as different students attending the dining hall,

differences in the menu, differences in student mood (“It’s Monday...” vs “TGIF”) etc. The model was run separately for the treatment and control dining hall.

To test if the change in measurement variables differed between the treatment and control dining halls, the data was pooled and a multivariate regression was run with addition of an interaction term between the post intervention period and the treatment dining hall (1 if post intervention in treatment dining hall, 0 otherwise). The coefficient of the interaction term provided a difference in difference estimate of relative change between the control and intervention dining hall. This allows determination of whether the changes in the intervention dining hall are statistically different from those in the control dining hall.

## **Results**

A total of 3,153 trays were observed over a period of two weeks (one week of pre intervention and one week of post intervention) in two dining halls (N=1564 in control and N=1589 in intervention). Summary statistic of the observed outcome variables and outcome measures is shown in Table 1. As shown in Table 1, the control and intervention dining halls were very similar at baseline with respect to the number and types of dishes (lunch plates, drink glasses, salad bowls, dessert plates) being returned at the end of the lunchtime meal. The control and intervention dining halls were also similar with respect to the study measures, number of dishes with leftover and number of lunch plates with leftovers.



Table 1: Summary statistic of the observed outcome variables and outcome measures

		Control		Intervention	
Observed outcome variables		Mean	S.D	Mean	S.D
Pre	Total number of lunch plates	1.83	(1.02)	1.76	(0.97)
	Total number of drink glasses	1.39	(0.86)	1.32	(0.95)
	Total number of salad bowls	0.16	(0.43)	0.12	(0.38)
	Total number of dessert plates	0.03	(0.18)	0.06	(0.27)
	No. of dishes with leftover	0.62	(0.71)	0.56	(0.68)
	No. of lunch plates with leftover	0.55	(0.64)	0.51	(0.63)
Post	Total number of lunch plates	1.92	(1.00)	1.66	(0.88)
	Total number of drink glasses	1.50	(0.87)	1.02	(0.80)
	Total number of salad bowls	0.12	(0.37)	0.14	(0.43)
	Total number of dessert plates	0.03	(0.19)	0.04	(0.20)
	No. of dishes with leftover	0.60	(0.69)	0.39	(0.55)
	No. of lunch plates with leftover	0.54	(0.64)	0.35	(0.53)

Multivariate regression based estimates on measures of food behavior (within group change) for the control and intervention dining halls are shown in Table 2. In the control dining hall there was a significant pre-to-post increase in the number of drink glasses and a significant decrease in the number of salad bowls. Meanwhile, in the intervention dining hall there was a significant decrease in five outcome variables after tray removal: 1) total number of lunch plates, 2) total number of drink glasses, and 3) total number of dessert plates, 4) number of dishes (salad

bowls, lunch plates or dessert plates) with leftover, and 5) number of lunch plates with leftovers,. There was an insignificant increase in total number of salad bowls in the intervention dining hall.

The difference in difference estimates (in Table 2) show a significant decrease in the following outcome variables in the intervention cafeteria, relative to control: total number of lunch plates, total number of drink glasses, number of dishes with leftover, and number of lunch plates with leftover. Tray removal also resulted in a significant increase in total number of salad bowls.

Table 2: Estimates for change in outcome variables due to tray removal

	Control		Intervention		Diff-in-diff	
	dining hall		dining hall		estimate	
	$\beta$	p value	$\beta$	p value	$\beta$	p value
Total number of lunch plates	0.088	0.086	<b>-0.100</b>	0.031	<b>-0.188</b>	0.006
Total number of drink glasses	<b>0.108</b>	0.014	<b>-0.299</b>	<.0001	<b>-0.407</b>	<.0001
Total number of salad bowls	<b>-0.048</b>	0.017	0.021	0.309	<b>0.070</b>	0.015
Total number of dessert plates	0.003	0.757	<b>-0.024</b>	0.039	-0.027	0.076
No. of dishes with leftover	-0.021	0.561	<b>-0.176</b>	<.0001	<b>-0.153</b>	0.001
No. of lunch plates with leftover	-0.008	0.811	<b>-0.162</b>	<.0001	<b>-0.152</b>	0.005

The first four columns of the tables are the estimated results for the control (first two column) and intervention (second two column) dining hall regressed separately. The estimates shown are for the binary post intervention variable. The difference in difference estimate on the relative change between the control and intervention dining hall is shown in the last two columns.

## **Comment**

In this quasi-experimental study of cafeteria tray removal, we found that students in a dining hall with no cafeteria trays available at lunchtime took fewer plates of food and fewer drink glasses relative to students in a dining hall where trays remained in place. However, the students without access to trays also ended up with relatively fewer leftovers on the plates they did use (i.e. less food waste), making it difficult to be certain about the policy's overall impact on caloric and nutrient consumption.

Environmental and policy changes that encourage people to make better choices when dining outside of their home may be one approach to promote more healthful diets and prevent obesity.<sup>7</sup> Unfortunately, drastic or costly policies do not tend to gain traction in the political or private realm. Simple and subtle interventions (“nudges”) such as menu labelling with calorie information are more likely to translate directly into policy and be accepted by the American Public.<sup>9</sup> A simple and low cost modification of the dining environment would be to remove trays from cafeterias and dining halls. While a true list is not available, several U.S. colleges and universities have “gone tray-less” as a cost saving, environmentally friendly measure to reduce food waste and water usage over the past few years. It is unknown, however, if this simple economical change might serve to trim the growing American waistline as well, especially the weight gain of college students as they enter college commonly termed as the “freshman 15”.

These results clearly suggest that students use fewer plates during lunch time if trays are removed. However, the impact of a tray-removal policy on caloric consumption from food is unclear. Because food waste decreased when trays were removed, it's possible that students were still eating the same number of calories despite using fewer plates (i.e. they were simply eating more of the food on each plate). One previous study reported a decrease in the percentage of

diners who took salad by 65.2% but no decrease in the percentage of diners who took dessert.<sup>10</sup> The decrease in drink glasses that we observed, on the other hand, has more promise to indicate that such a policy could have a meaningful impact on caloric consumption. Sugar-sweetened beverage consumption is a key determinant of obesity in the United States,<sup>11</sup> and may have a number of other negative impacts on health.<sup>12-14</sup> Although we cannot be certain whether drink glasses contained exclusively sugar-sweetened beverages (as opposed to diet soda or water), on average it is likely that calories from beverages decreased as a result of this intervention. We did not observe an effect of tray removal on number of dessert plates, unfortunately. A previous study also reported no decrease in the percentage of diners who took dessert.<sup>10</sup> However, the study was based on a smaller sample size (N=417) compared to the current study and was conducted over a very short period of time, in two evenings one with tray service and one without. There are limited studies that look at the impact of the switch to tray less system on students' food choice and dietary behavior of college student. In this study we measured the number of lunch plates, drink glasses, salad bowls and dessert plates separately in addition to observing the number of dishes and lunch plates with leftovers to better understand the impact of tray less dining on food behavior.

Because sustainability and reducing food waste are important goals of the University, and served as the impetus for this natural experiment, it is important to review these impacts of tray removal as well. The Office of Sustainability estimates, based on this pilot, that approximately 18,849 gallons of water and 107,142 pounds of food would be saved per semester due to elimination of waste from going tray less. Similar decreases in solid waste have been reported in switching from tray to a tray less system.<sup>15,16</sup>

### ***Limitations***

The major limitation of our study is that we did not measure food / caloric intake directly, or look at consumption according to additional important factors such as added sugars, saturated fats, or sodium. The tray waste data that we did collect allows some insight on what is being consumed vs. trashed (beyond bulk consumption data at the preparation level), but is nonetheless limited in that we did not have a thorough enough assessment to gather nutrient-level information. For example, the decrease in the number of drink glasses could represent a decrease in the consumption of water and not fruit juice. Another limitation of this study is that we did not examine whether students who took fewer plates or glasses at lunchtime made substitutions or trade-offs in their consumption later, outside the university dining hall, with extra snacks or larger meals elsewhere. We feel that the chances of this happening in the present study are low, because of the nature of the university meal plan, which acts as a disincentive for students to eat anywhere outside of the dining halls, where all of their food is already paid for.

### ***Conclusions***

In the present-day U.S., many universities have gone trayless for sustainability reasons. Our results reinforce that going trayless does reduce food and water waste, however they also suggest that removing trays may reduce beverage consumption, and possibly overall caloric consumption, without decreasing salad intake, a concern raised previously in the limited literature on this topic.<sup>10</sup> More studies are needed that look not only at the number of plates, but also aim to estimate caloric consumption, as well as measuring certain key macronutrients such as fats and added sugars. In the meantime, for colleges and universities looking to make easy changes to choice architecture at minimal cost, several low cost interventions have been developed that may promote healthy consumption by students.<sup>17</sup> Such strategies may be useful

for university cafeterias that wish to promote healthy food habits among college students as they become independent adults.

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