

Location of School Lunch Salad Bars and Fruit and Vegetable Consumption in Middle Schools: A Cross-Sectional Plate Waste Study



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ABSTRACT

Background The school lunch environment is a prime target for increasing a child's consumption of fresh fruits and vegetables (F/V). Salad bars are heavily encouraged in schools; however, more research is needed to examine the contexts in which salad bars promote consumption of F/V among students.

Objective To compare the amount of fresh F/V self-served, consumed, and wasted by students during lunch at schools with differing salad bar placement: inside or outside of the serving line.

Design Cross-sectional plate waste study in which salad bar placement differed between schools.

Participants/setting A random sample of middle school students (N=533) from six schools (three schools per district).

Main outcome measures Amount of fresh F/V taken, consumed, and wasted.

Statistical analyses Negative binomial multivariable regression examined placement of salad bars, adjusting for sex, grade, race/ethnicity, free/reduced status, day of the week, and nesting of students within schools.

Results Almost all students (98.6%) in the schools with salad bars inside serving lines self-served F/V compared with only 22.6% of students in the schools with salad bars outside lines (adjusted prevalence ratio=5.38; 95% CI 4.04 to 7.17). Similarly, students at schools with salad bars inside the line had greater prevalence of consuming any F/V compared with students in schools with salad bars outside the line (adjusted prevalence ratio=4.83; 95% CI 3.40 to 6.81). On average, students with the salad bar outside the line wasted less F/V compared with those with salad bars inside the line (30% vs 48%, respectively).

Conclusions Few students visited salad bars located outside the lunch line. Salad bars inside the lunch line resulted in significantly greater fresh F/V taken, consumed, and wasted. When possible, schools should try to include salad bars inside the line to increase students' exposure to F/V.

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FRUIT AND VEGETABLE (F/V) CONSUMPTION IS LOW among children¹ and tends to decrease by one serving per day on average over adolescence.² Identifying means to increase fresh F/V consumption among middle school students is critical to prevent further declines as youth transition into young adulthood.

The National School Lunch Program is a venue for improving millions of students' access to F/V.^{3,4} Providing fresh F/V on salad bars during lunch is an approach schools have been encouraged to use to boost student F/V exposure and intake.⁵ Since its launch in 2010, the Let's Move Salad Bars to Schools initiative has raised more than \$10 million to help schools gain access to salad bar equipment and has distributed more than 4,000 salad bars by early 2015.⁶ In a March 2013 memo to Regional and State Directors of Child Nutrition Programs, the US Department of Agriculture (USDA) provided guidance to schools for salad bars stating, "We

encourage school food authorities to incorporate salad bars into their school food service operations when possible..."⁷

Recent national prevalence estimates indicate 39% of middle school students have at least one salad bar available during lunch (either à la carte or hot lunch line).⁸ Surveys also show that middle and high schools are more likely to report having salad bars compared with elementary schools.^{9,10} However, few peer-reviewed studies have examined the independent effects of salad bars on children's F/V consumption, waste, or participation rates in middle schools. Gosliner¹¹ found students' self-reported vegetable consumption was 48% greater among a mix of high school and middle school students in schools with salad bars compared with schools without.¹¹ A nationally representative survey observed that self-reported consumption of green vegetables by middle school students was greater by about 7% in schools with a salad bar either à la carte (ie, available for purchase

separately from the school lunch meal) or part of the serving line.⁸ Implementing salad bars to increase consumption has been studied in only a single study among elementary school students. The study suggested that self-reported F/V consumption may increase after salad bars are implemented in elementary schools.¹² An observational study among elementary school-aged students showed that contextual factors (ie, variety of F/V items) were positively related to students' F/V intake and negatively related to waste, regardless of salad bar presence.¹³ However, significant gaps in the evidence exist and reveal little is known about where the ideal placement of salad bars may be to promote fresh F/V consumption and limit waste once salad bars are present in cafeterias.¹⁴

Behavioral economics posits that personal choices can be nudged by contextual factors such as competing choices, default placements, prompting, and other factors that may generalize to students' choices in school lunchrooms.¹⁵⁻¹⁸ For example, Hanks and colleagues¹⁵ evaluated how creating a "smarter lunchroom" by modifying the convenience (eg, healthy convenience line), attractiveness (eg, descriptive names for vegetables), and normativeness (eg, last chance for fruit sign) resulted in greater F/V consumption among adolescents (grades 7 to 12). Such findings suggest that unappreciated environment factors may also increase use of salad bars. Potentially, simple choice-point factors such as placement of the self-serve bar before vs after the point of purchase may influence student F/V intake. Bruening and colleagues (M. Bruening, M. A. Adams, J. C. Hurley, P. Ohri-Vachaspati: unpublished data, August 2014) found that the majority of primary and secondary schools in Arizona place the salad bar after the point of purchase.

The purpose of the present study was to compare the amounts of fresh F/V self-served, consumed, and wasted by middle school students in schools with different salad bar placements. Students in schools with salad bars inside the serving line were compared with those with a salad bar outside the line (ie, before vs after the point of purchase). We hypothesized that students in schools with salad bars inside of the serving line would self-serve and consume greater amounts of fresh F/V and waste less.

MATERIALS AND METHODS

Study Design

A cross-sectional comparative study was conducted across two school districts with existing salad bars, both in the greater Phoenix, AZ, region. A total of 533 students attending six middle schools (three schools in each district) were randomly selected. Districts and their schools differed by the placement of their salad bar during the lunch period: within the serving line before the point of purchase in one district or outside the main serving line after the point of purchase in the other district. [Table 1](#) shows F/V items available across schools and salad bar conditions. In schools with salad bars inside the line, fresh F/V items were available from the salad bar or as standalone items on display (eg, whole fruits and bagged vegetables) all before the point of purchase. Standalone items and juice were also available before the point of purchase in schools with salad bars located outside the line. Each school had a single existing salad bar in operation. The research team visited each school on a single day only

and balanced sampling of schools across districts on day of the week (Mondays or Fridays) and lunch entrée or main protein served (eg, pizza or chicken). To obtain accurate measurements, the research staff asked school staff to conduct their activities as normal and not to encourage students to change their behavior because of the presence of research staff. School visits occurred during late August through September 2013. Research staff was trained over 3 days before visiting any school using a mock cafeteria to practice recruitment and measurement procedures. The ethics review board at Arizona State University approved the research study procedures.

Study Size and Power Analysis. *A priori* power analyses revealed a minimum sample of 540 students needed across six schools to detect a difference of ≥ 25 g ($\sigma=60$ g) between salad bar conditions with $\alpha=.05$ and 80% power with a maximum intracluster correlation of 0.03. Effect and variance estimates were based on a prior study with salad bar plate waste in elementary schools.¹³

Student Sampling. School districts provided lists of students enrolled at the beginning of the school year in each school along with their student identification number (ID), sex, age, grade, ethnicity and racial status, and free/reduced meal status. Research staff underwent approximately 10 hours of training to practice logistics and weighing methods in a mock cafeteria environment before working in schools. School principals acted in loco parentis for the parents and provided informed consent before data collection and students gave verbal assent before participating. The only eligibility criterion for enrolled students was that the student obtained a hot entrée lunch the day of the school visit.

Before the day of data collection, a list of randomly selected student IDs was created for recruitment. While students queued in the hot entrée line, they were asked for their ID numbers and when a match was identified, the student was briefly informed of the study and invited to participate. Research staff provided assented students an empty lunch tray and/or boat with a study ID number and the tray/boat weight marked in grams on a brightly colored label. Students were asked to proceed through the serving line and select their lunch items as usual, but were not told of the specific food items of interest.

Immediately after the point of purchase, students emerging from the serving line were identified by research staff via the colored labels on trays/boats and guided to the nearby measurement table. F/V, not including the entrée or fruit juice, were weighed in the labeled tray/boat on a digital gram scale (Taylor TE32C) accurate to 1 g. The tray/boat ID, tray/boat weight, entrée choice, and fresh F/V weight were recorded. Only in schools with salad bars outside the line, another measurement table and a second set of labeled preweighed boats were placed adjacent to the salad bar. Only F/V taken at the bar was weighed in the labeled boat. Researcher staff did not interact with students while they were eating lunch, but staff monitored waste receptacles and collected labeled trays/boats directly from students as they approached the receptacles. Students were thanked and provided a small incentive for completing the study (eg, colorful stress ball) when they returned their labeled trays/boats.

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