

Fruit and vegetable consumption in schools: Are salad bars an effective strategy for improving consumption?

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Disclosures

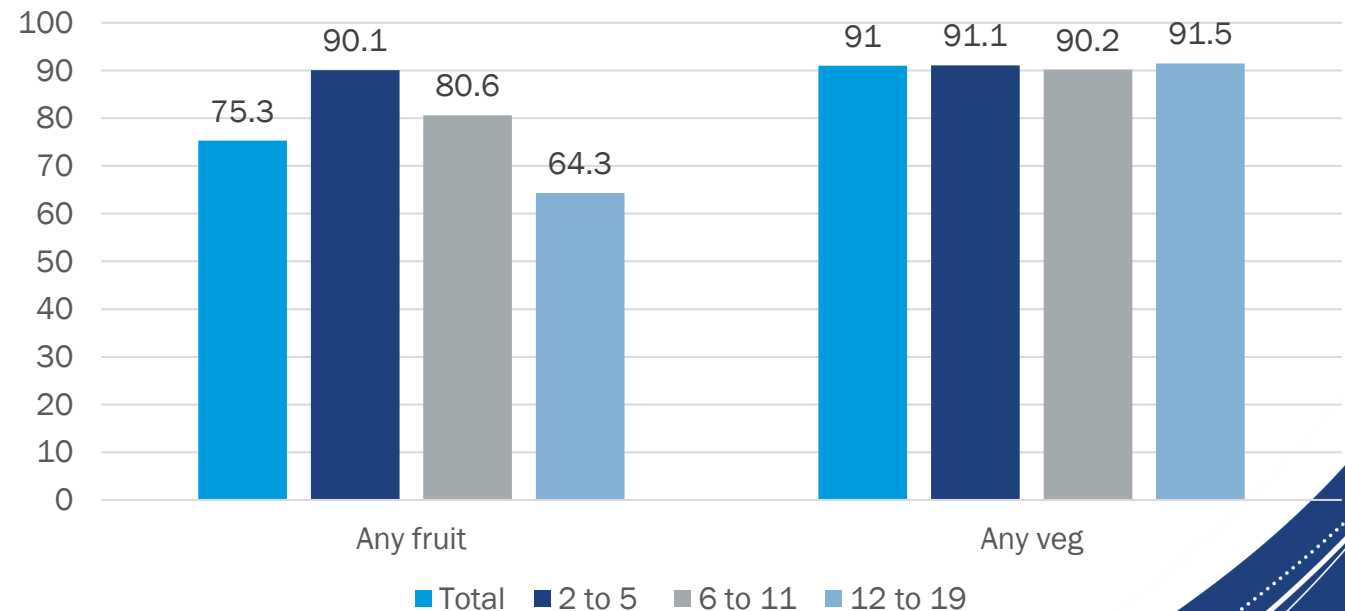
Funding from the National Dairy Council to examine milk and its relationship to fruit and vegetable intake.

No information on dairy will be presented today.

Youth consume too few FVs

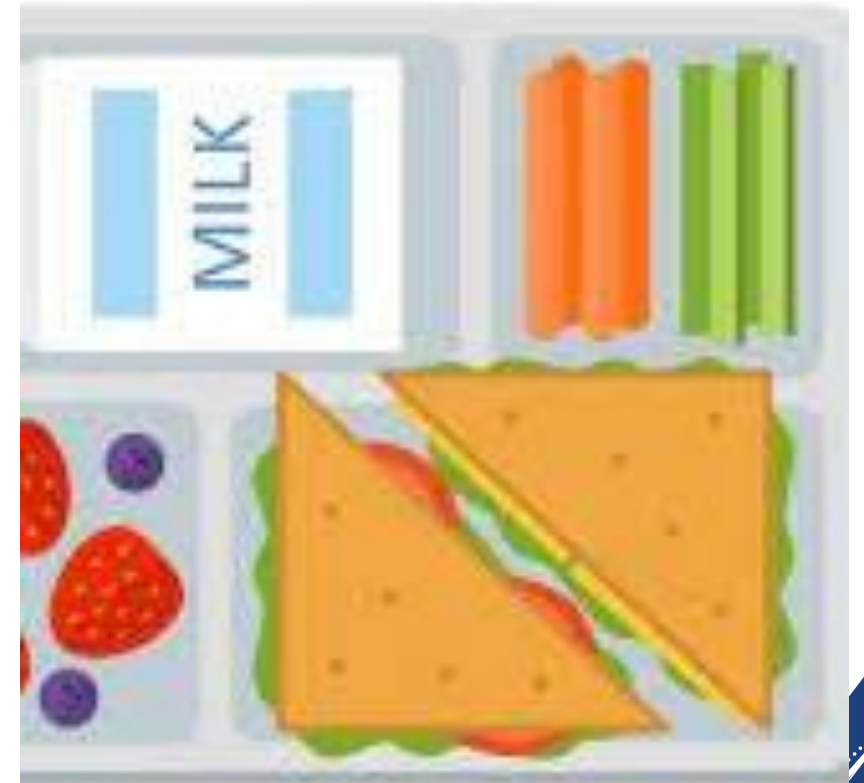
- Less than 10% consume recommended amounts of FVs
- FV consumption declines as youth get older

Percent of Children who Consume Any Fruits or Any Veg on a Given Day (NHANES 2015-2018)



The National School Lunch Program is a key environment to promote healthy eating for children

- ~30M youth participate in school lunch
- 70% of youth receive meals at free/reduced priced
 - 130% of the federal poverty line
 - Cost of lunch:
\$3.50, \$0.40(reduced); \$0.00 (free)
- Meals align with *Dietary Guidelines for Americans*



School lunches



School Meals Just Got Healthier, 2013

Health Hunger Free Kids Act of 2010

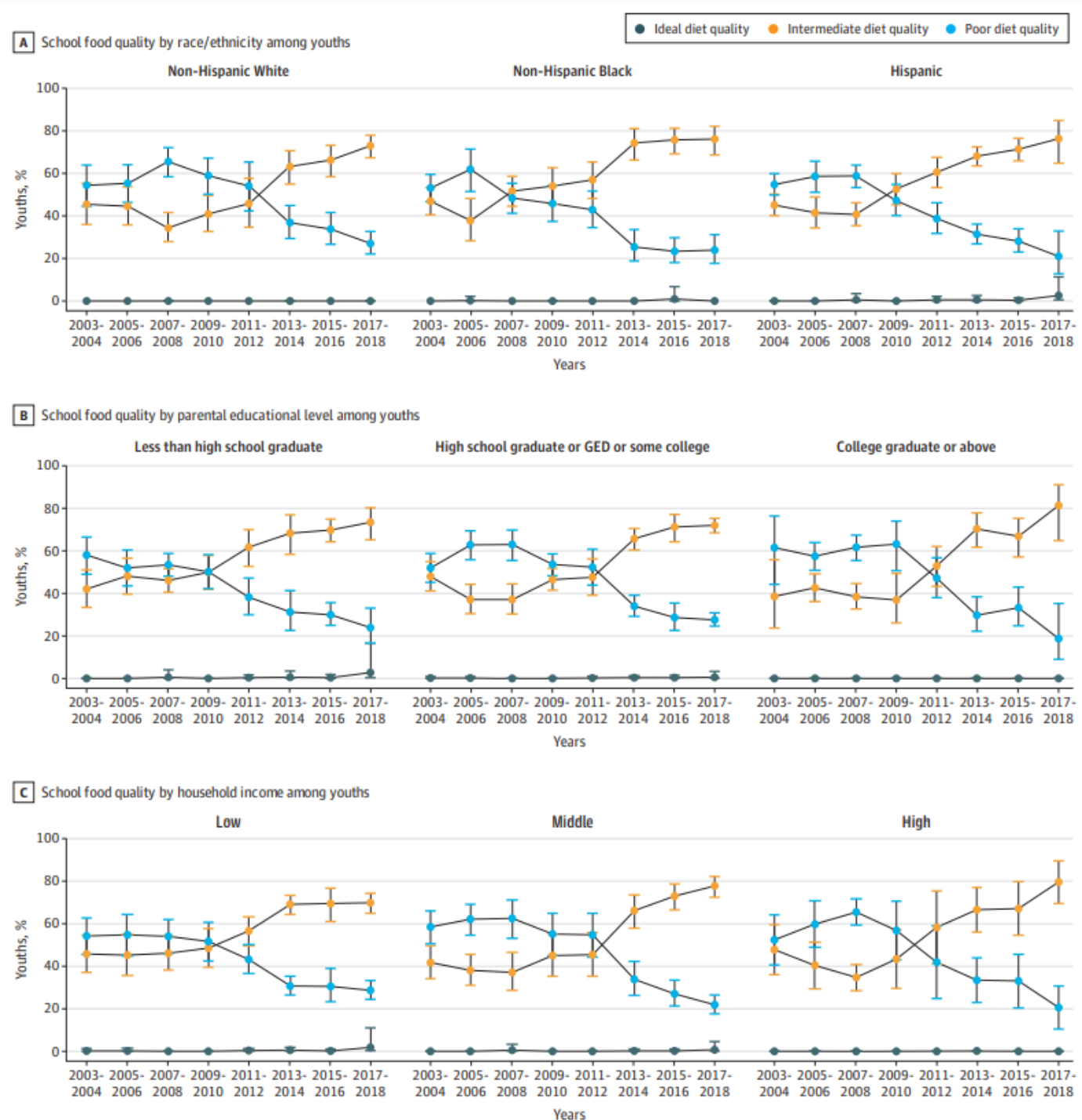


School Meals Just Got Healthier, 2013

Nutrition security:

Consistent and equitable access to healthy, safe, affordable foods essential to optimal health and well-being

School meals(HHKA) promote nutrition security and equity



Approaches for Increasing F&V Intake in Schools

- Increase accessibility
- Increase variety
- Attractiveness
- Encouragement
- Special events (kick-offs, samplings, challenge weeks, etc)
- Get students involved

salad bars *could* be the answer

School salad bars as an intervention to support FV intake

- Approach to promote FV consumption & meet regulations
 - Variety
 - Self-served (choice)
 - Nudges
- 6100+ salad bars in schools, with a waiting list 300+
- Cost for salad bars ~\$3000
- Evidence on school salad bars is lacking:
 - Design concerns: Observational, quasi-experimental
 - Measurement concerns: self-report, production records
- Very little evidence for middle and high schools





Promotion

School Meals: Building Blocks for Healthy Children

CDC Home
Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™

A-Z Index [A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#) #

Overweight and Obesity

Overweight and Obesity

- [Strategies to Combat Obesity](#)
- [Adult Overweight and Obesity](#)
- [Childhood Overweight and Obesity](#)
- [Basics About Childhood Obesity](#)
- [A Growing Problem](#)
- [Strategies and Solutions](#)**
- [Childhood Obesity Demonstration Project](#)
- [Data and Statistics](#)
- [State and Community Programs](#)
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Other Healthy Living Topics

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- [Physical Activity](#)
- [Breastfeeding](#)
- [Healthy Weight](#)

Other Chronic Disease Topics

- [Diabetes](#)
- [Heart Disease](#)
- [Stroke](#)

[Strategies and Solutions](#)

There is no single or simple solution to the childhood obesity problem, and parents can do to help make the health of their children, and their families.

States and communities can:

- Assess their retail food environment to better understand the current landscape and difference accessibility to healthier foods. See [Healthier Food Retail: Beginning the Assessment Process in Your State or Community](#) [PDF-52]
- Provide incentives for supermarkets, farmers markets, or other retail models to establish their businesses in underserved areas or to sell and promote healthier foods. See [The Healthy Food Access Portal - Retail Strategies](#) [PDF-52]
- Expand programs that bring local fruits and vegetables to schools. See [National Farm to School Network](#) [PDF-52]
- Put salad bars in schools. See [Let's Move Salad Bars to Schools](#) [PDF-52]
- Pursue a "Spectrum of Opportunities" to help eat jurisdictions support optimal nutrition, breastfeeding standards and practices. See [Spectrum of Opportunities for Obesity Prevention: Technical Assistance Briefing Document](#) [PDF-4.71Mb] [PDF-4.71Mb] and [Early Care and Education: Increasing Support](#) [PDF-3.76Mb]
- Enroll elementary, middle, and high schools in U Nutrition program and apply for certification through HealthierUS School Challenge. See [USDA Team Nutrition and HealthierUS School Challenge](#)
- Increase access to drinking water and other healthy beverages in early care and education facilities. See [Increasing Access to Drinking Water and Other Healthier Beverages in Early Care and Education Settings](#) [PDF-3.76Mb]
- Increase access to free drinking water and limit added sugars in schools by establishing school wellness and nutrition policies. See [Nutrition Standards for Foods in Schools and Water in Schools](#)
- Support breastfeeding in hospitals and the workplace. See [Breastfeeding Promotion & Support to find out how Health Care and Employment can support breastfeeding.](#)

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Salad Bars = Easiest Way for Schools to Meet the New

Dark Green, Red



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PERSPECTIVE

Let's Move Salad Bars to Schools: A Public-Private Partnership To Increase Student Fruit and Vegetable Consumption

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Abstract

Few school-age youth consume the recommended amounts of fruits and vegetables, and increasing fruit and vegetable intake in children and adolescents is an important public health goal to maintain long-term good health and to decrease risk of chronic disease and obesity. School salad bars are an important tool to promote fruit and vegetable consumption among schoolchildren. Studies show that introduction of school salad bars increases the amount and variety of fruits and vegetables consumed by children in schools. However, many schools cannot afford the capital investment in the salad bar equipment. In 2010, the National Fruit & Vegetable Alliance (NFVA), United Fresh Produce Association Foundation, the Food Family Farming Foundation, and Whole Foods Market launched Let's Move Salad Bars to Schools (LMSB2S) in support of First Lady Michelle Obama's *Let's Move!* initiative. The goal of LMSB2S is to place 6000 salad bars in schools over 3 years. As of June, 2012, over 1400 new salad bar units have been delivered to schools across the United States, increasing access to fruits and vegetables for over 700,000 students. Any K through 12 school district participating in the National School Lunch Program is eligible to submit an application at [www.saladbars2schools.org/](#). Requests for salad bar units (\$2625 each unit) are fulfilled through grassroots fund raising in the school community and through funds raised by the LMSB2S partners from corporate and foundation sources. LMSB2S is a model for coalition-building across many government, nonprofit, and industry partners to address a major public health challenge.

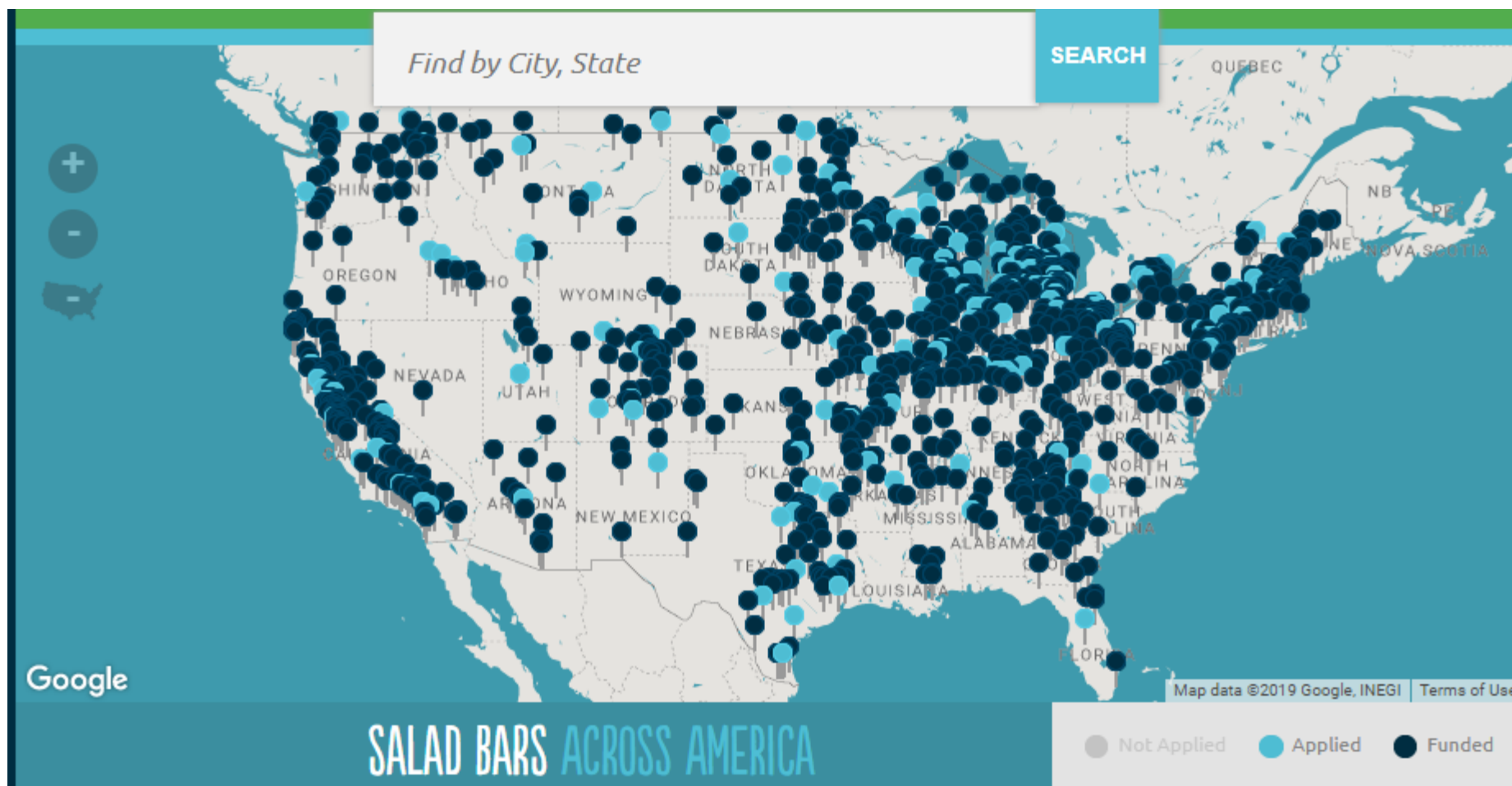
Introduction

Increasing fruit and vegetable intake is important for good health and may decrease risk for many chronic diseases, including heart disease,¹ stroke,² diabetes,³ and some cancers.⁴ In the context of obesity, increased fruit and vegetable intake may assist in healthy weight management when energy-dense foods are replaced by fruits and vegetables.⁵ Fruits and vegetables also provide a variety of micronutrients and fiber, and therefore, are targeted in the Dietary Guidelines for Americans, 2010, as two foods to increase to maintain overall health and reduce the risk of chronic disease and obesity.⁶ Additionally, diet quality

performance.⁷ However, few school-age children consume the recommended amounts of fruits and vegetables. Data from the National Health and Nutrition Examination Survey 2003–2004 found that only 6.2% of adolescents (12–18 years old) met recommendations for fruit intake and 5.8% for vegetable intake.⁸ Helping children develop good eating habits early in life is critical for maximizing academic performance during the school years and for maintaining wellness throughout their lives.

Schools can play an important role in promoting consumption by increasing access to fruits and vegetables and giving students opportunities to learn about and practice healthful eating behaviors. Several federal initiatives

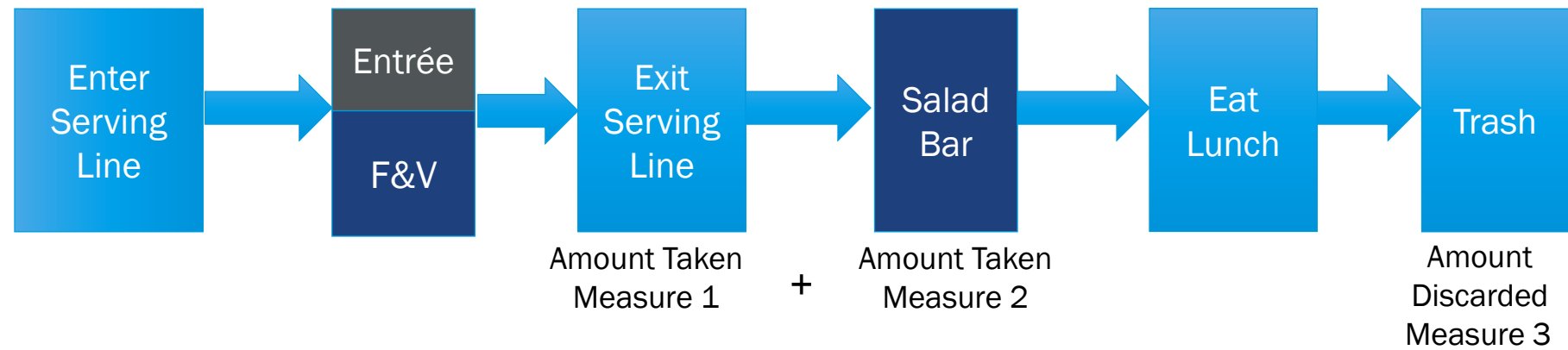
Let's Move Salad Bars to Schools



Pilot study: How does placement of SBs impact consumption?

- Cross-sectional study
 - 2 conditions
 - District w/salad bars outside line (3 schools)
 - District w/salad bars inside line (3 schools)
 - 533 students from 6 middle schools
 - Students randomly sampled on a single day from each school
 - Selected school days with similar entrées and matched on day of the week (Mondays & Fridays)
 - Plate waste methodology
- 

Condition 1:
Salad Bar Outside Serving Line



Condition 2:
Salad Bar Inside Serving Line

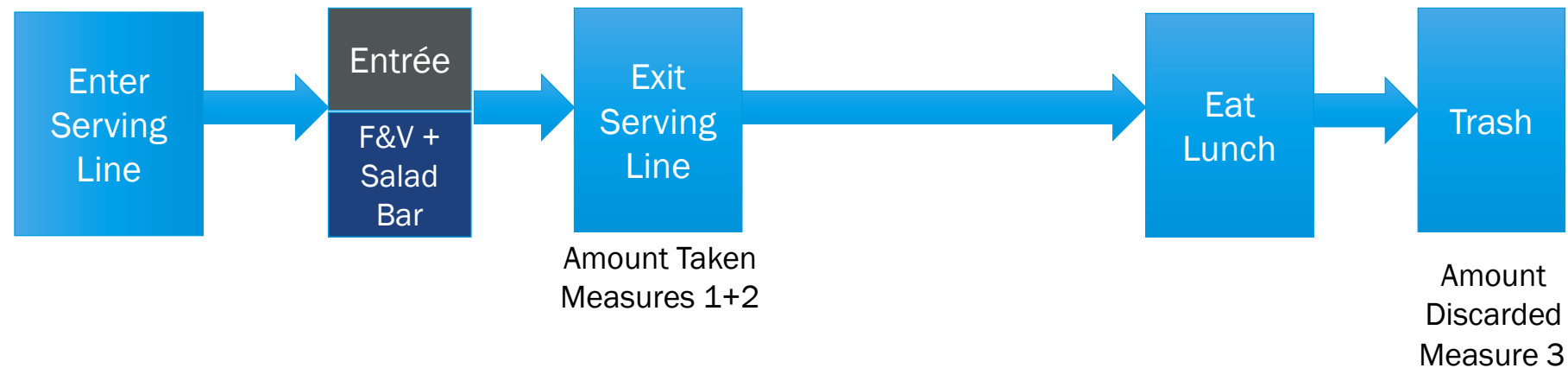










Plate waste methodology

- Weighed amounts taken and discarded using digital gram scales
- Estimated amount self-selected, consumed and wasted
 - Self-selected (g) = amount taken from salad bar
 - Consumed (g) = amount taken – amount wasted
 - Wasted (%) = amount consumed / amount taken
- Mixed negative binomial model adjusting for gender, grade level, race/ethnicity, free/reduced status, day of the week, and nesting of students within schools
- Results presented in two ways:
 - None v. Any
 - Amounts (g)

Fresh F&V Taken & Salad Bar Placement

	Yes, Took Something	No, Took Nothing	
Inside Serving Line	290	4	294
Outside Serving Line	54	185	239
			533 students

Inside Line Prevalence = 98.6%

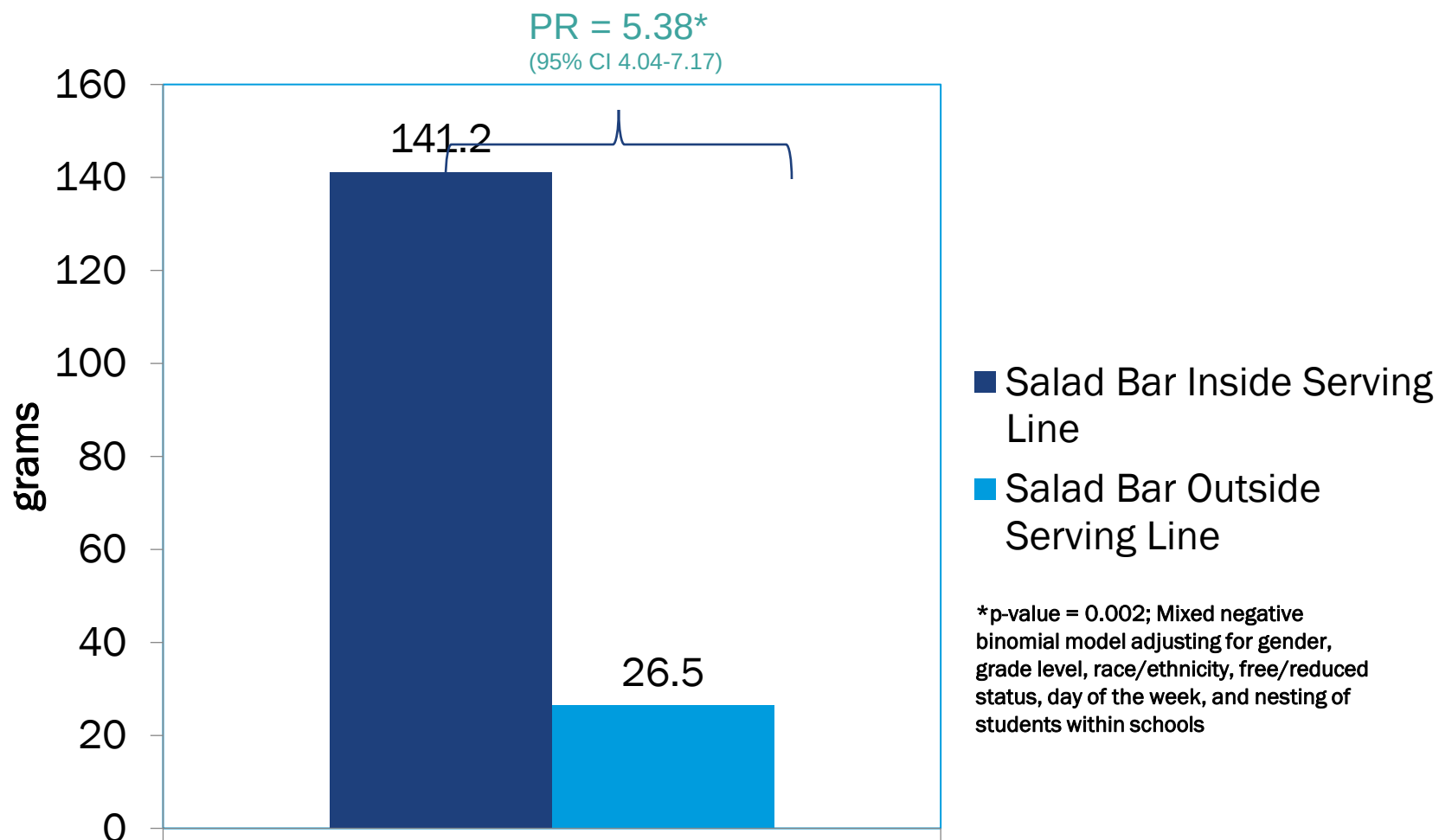
Outside Line Prevalence = 22.6%

Unadjusted Prevalence Ratio_{inside} = 4.36 (95% CI 3.65-5.52)

~4.4x More Students Took Fresh F&V
When Salad Bar Located *Inside* Service Line

Only 13 of 239 (5.4%) students took F&V from salad bars
when the bar was located outside of the serving line.

Amounts of Fresh F&V Taken by Placement



Reference:

50 grams = 5 medium baby carrots

72 grams = 1 cup, shredded iceberg lettuce

138 grams = 1 medium apple

Fresh F&V Consumed

		Yes, Ate Something	No, Ate Nothing	
Inside Serving Line		241	25	266
Outside Serving Line		49	188	237
				503 students

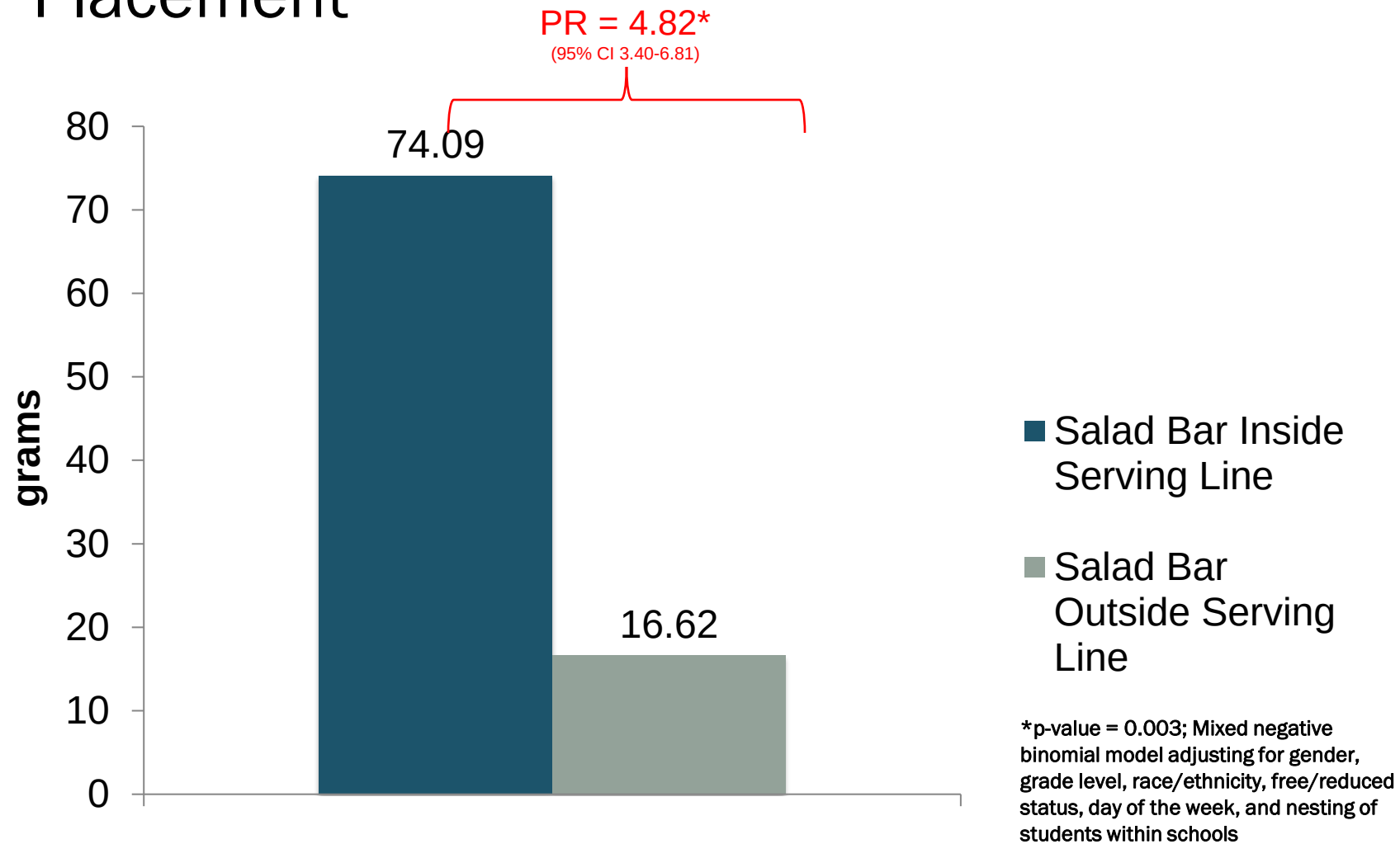
Inside Line Prevalence = 90.6%

Outside Line Prevalence = 20.7%

Unadjusted Prevalence Ratio_{inside} = 4.38 (95% CI 3.42-5.66)

~4.4x More Students Ate Fresh F&V
When Salad Bar Located *Inside* Service Line

Amounts of Fresh F&V Consumption by Placement



Reference:

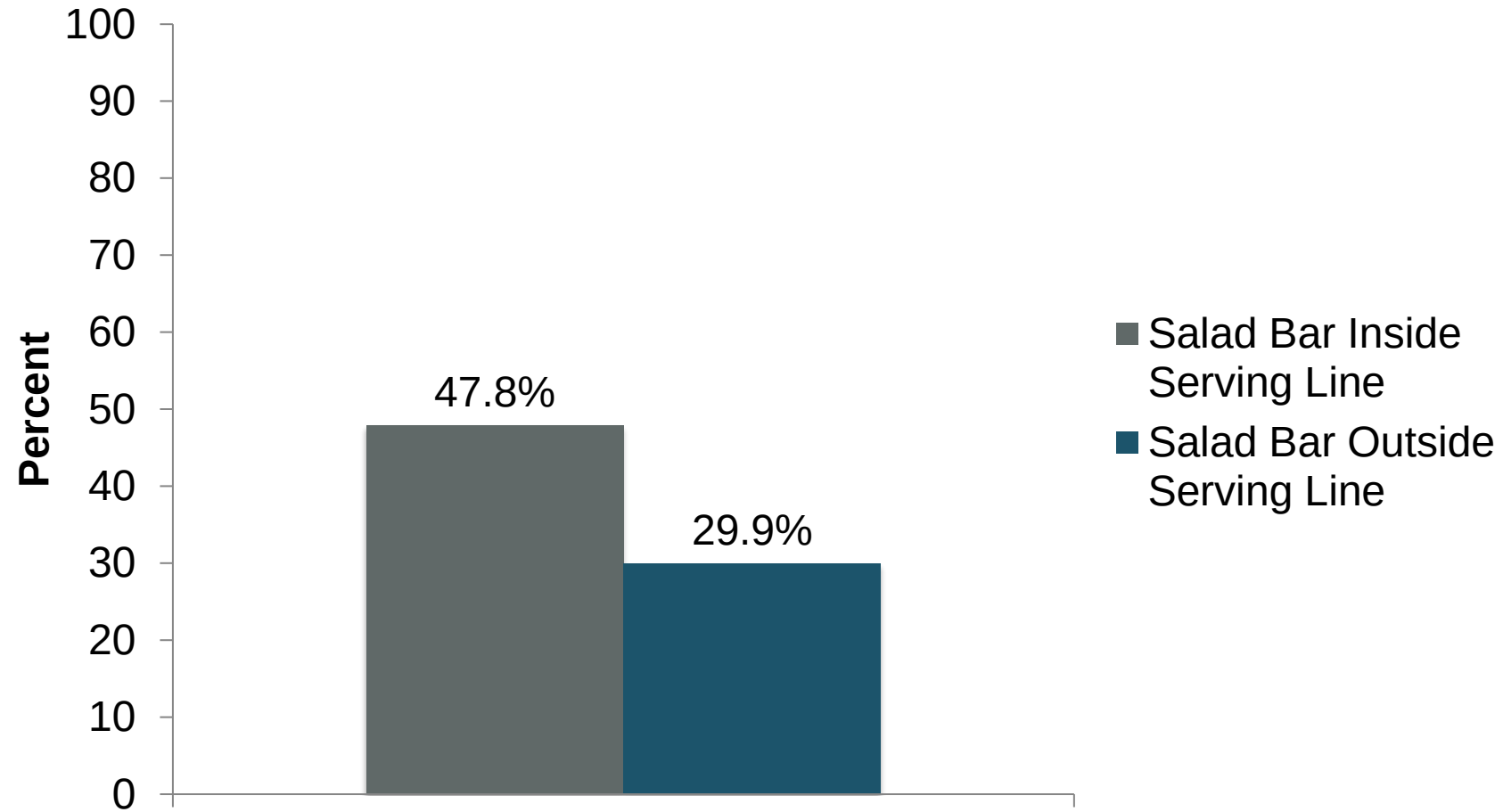
50 grams = 5 medium baby carrots

72 grams = 1 cup, shredded iceberg lettuce

138 grams = 1 medium apple

Waste & Salad Bar Placement

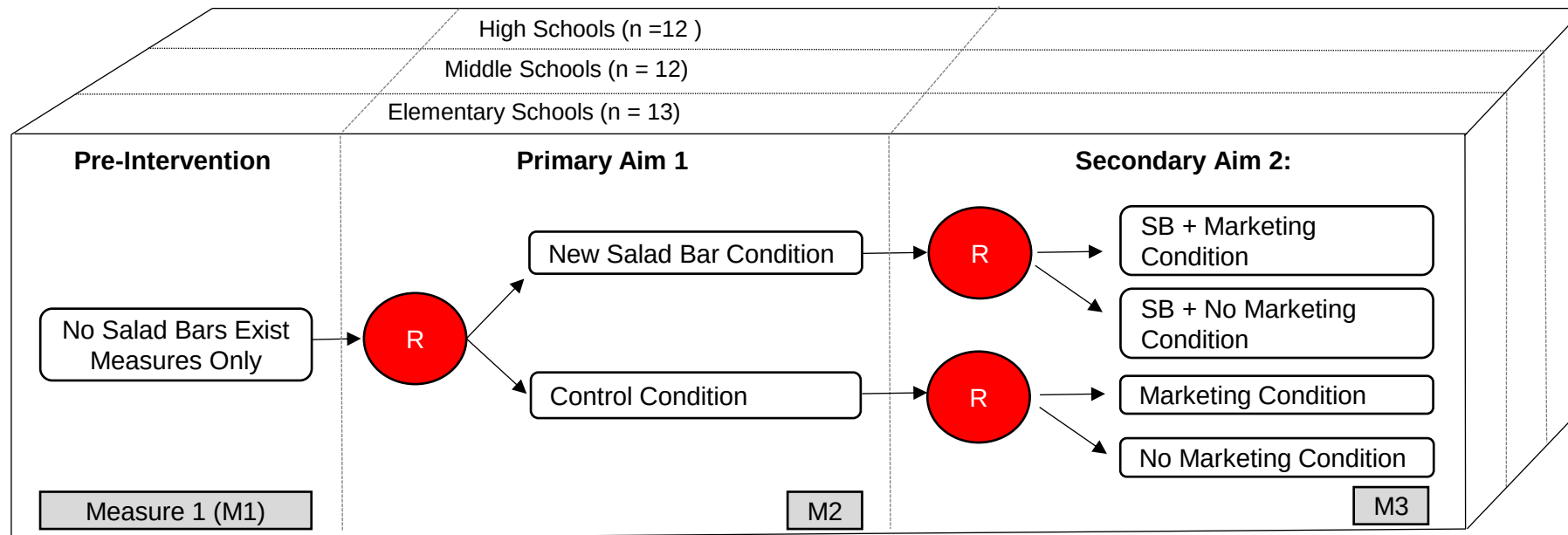
Among children that took any F&V...



Salad bars and students' fruit and vegetable consumption: A group-randomized trial with objective assessments (NHLBI R01 funded at the 2nd percentile)

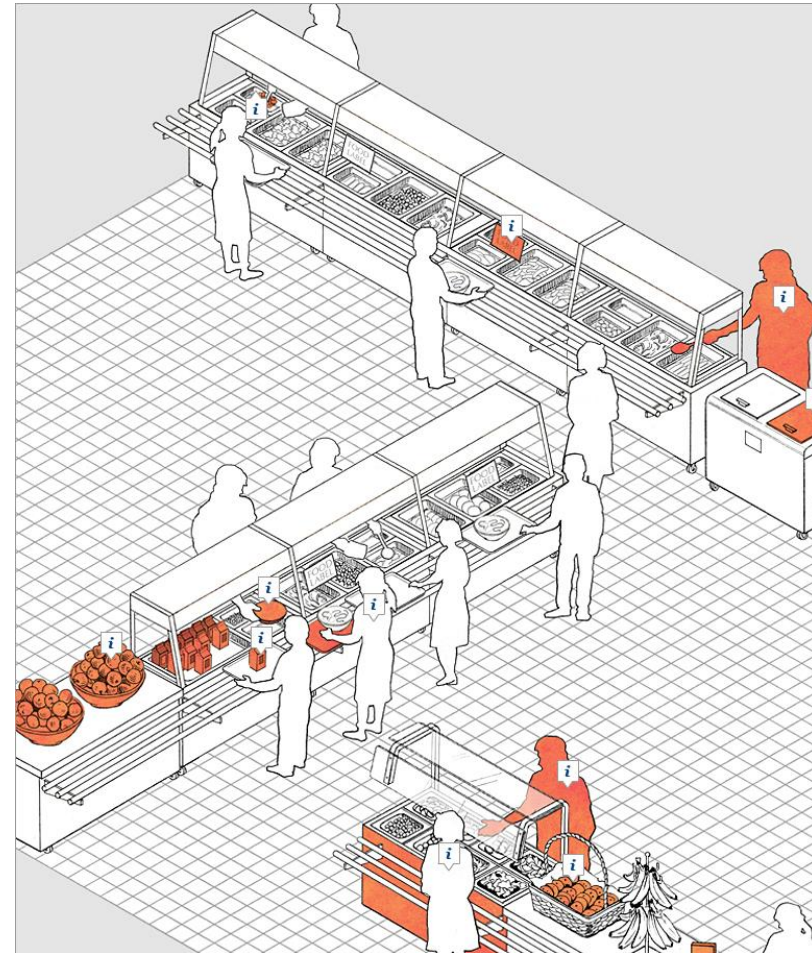
- Compare FV consumption in schools without salad bars to those with new salad bars by grade level
 - Assess how FV marketing to students changes FV consumption
 - Examine how placement of salad bars in cafeterias impact school-age children's FV consumption
 - Compare FV plate waste in schools: with and without salad bars; with and without marketing; with salad bars inside the line vs. outside the line
 - Compare economic impact of meeting FV recommendations in schools with vs. without salad bars
- 

Overview of study design



Behavioral economics

- Choices are not rational
- Context matters
- Defaults
 - Order of competitive options
- Placement
 - Response effort
- Relative Costs
 - Opportunity costs



Timeline of measurement activities by year

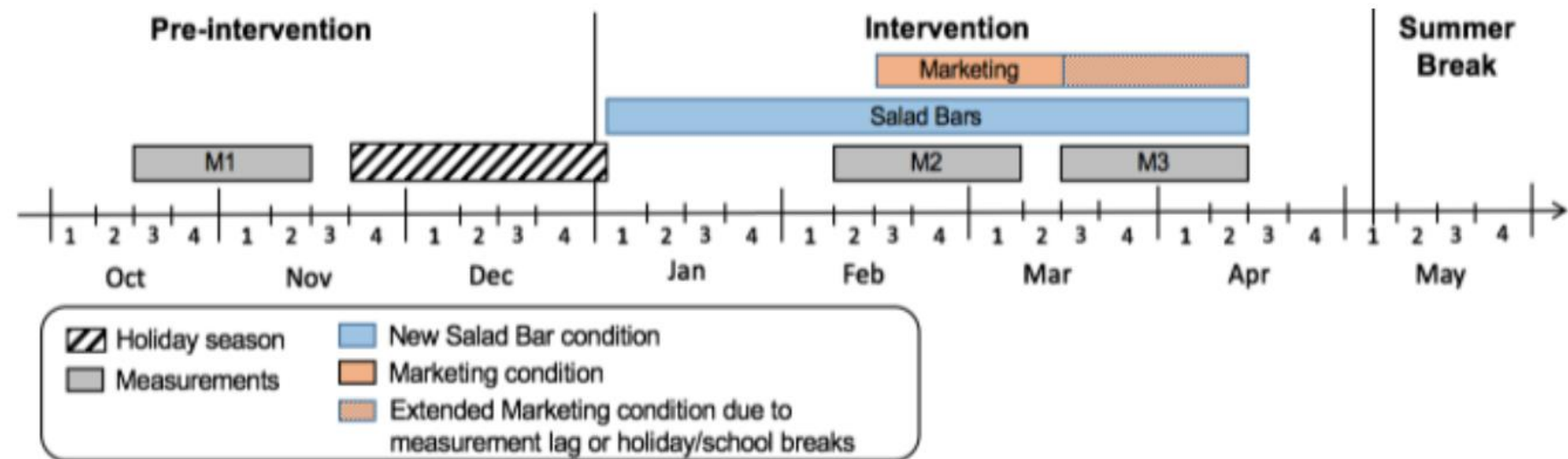


Figure 2. Timeline of measurement and intervention activities over the school year.



Salad Bar

TEST ELEMENTARY SCHOOL
2035-12-31

Go Firebirds!

0 Assented

Student ID: 11482

Enter Student ID

CHECK QUALIFICATION

SPANISH

Hi! My name is Daisy and I'm from Arizona State University in Phoenix. Can you tell me what grade you are in? I'm visiting your school cafeteria today to see what kids eat for lunch. I'm asking students like you to let me weigh and take a picture of their lunch tray. If you're ok with this then you will need to go to have your lunch tray weighed and photographed (point to weigh station) before you eat anything! After we weigh your tray then you can sit down and eat your lunch. Nothing will happen to your lunch –

REFUSE

ASSENT

Salad Bar

TEST ELEMENTARY SCHOOL
2035-12-31

Go Firebirds!

0 Assented

Student ID: 1147

Enter Student ID

CHECK QUALIFICATION

Sorry, you are not eligible!!
Thank you for your time



Measures: Objective Plate Waste

Objective Aggregate Plate Waste

- Weighed entire lunch and FV only
- Pre-Lunch and Post-Lunch Photos taken of scale weights

FV Consumption =

Pre-Lunch FV only weight (g) minus Post Lunch FV Only (g)

Example: 146 g – 66 g = 80 g consumed

Sociodemographics provided by the schools, by student: sex, grade, race/ethnicity, free/reduced status

Pre-lunch
Full Lunch



Pre-lunch
FV Only



Post-lunch
Full Lunch



Post-lunch
FV Only





Analyses

- Review descriptive data and covariates
 - sex, grade, race/ethnicity, free/reduced status, school clustering, and presence of salad dressing
- Zero-inflated negative binomial model (ZINB; with loglink) best fit the data. ZINB models comprise two sub-models:
 - A zero-Inflation (ZI) model for any consumption vs. no consumption
 - A conditional model for the non-zero consumption values (i.e., grams of FV consumed, given any consumption)

Elementary student characteristics

Female, n (%)	1495 (48.5)
Race/ethnicity, n (%)	
Non-Hispanic White	788 (25.6)
Hispanic (any race)	1899 (61.6)
American Indian/Alaska Native	98 (3.2)
Asian/Pacific Islander	82 (2.7)
Black/African American	216 (7.0)
Grade, n (%)	
1	502 (16.3)
2	560 (18.2)
3	686 (22.3)
4	681 (22.1)
5	654 (21.2)
Free/Reduced price lunch, n (%)	2460 (79.8)

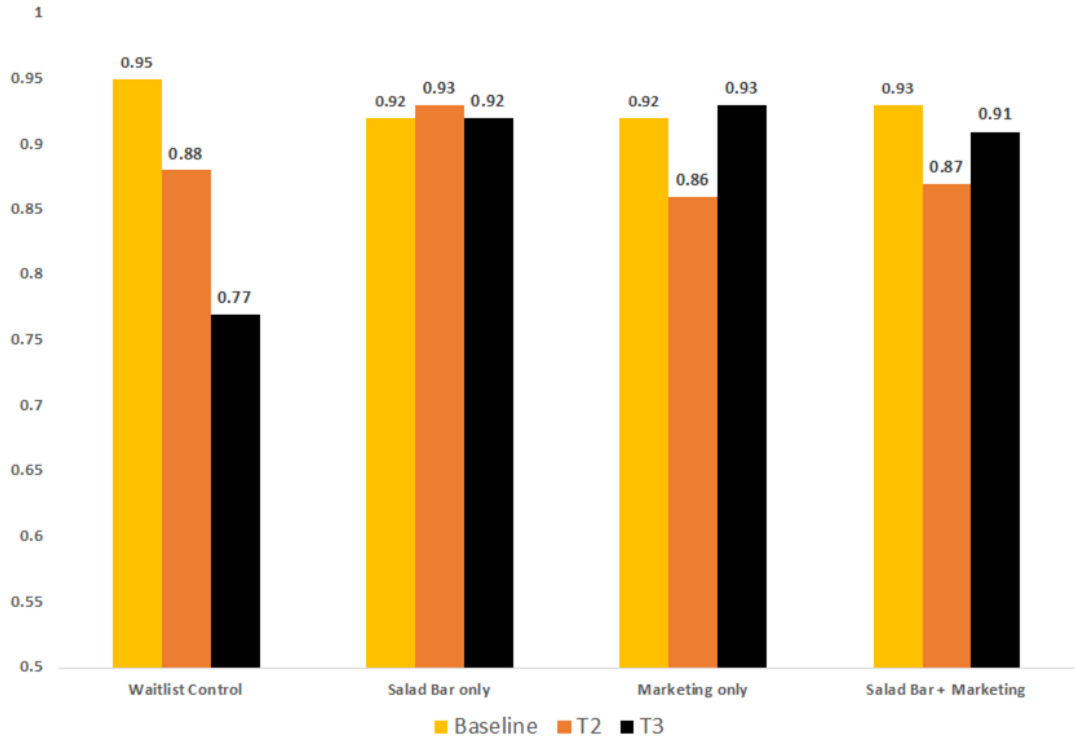
Observations with No FV Consumption and Salad Dressing Present

Condition	Percent of observations with no FV consumption			Percent of observations with salad dressing present		
	Baseline	Wave 2	Wave3	Baseline	Wave 2	Wave 3
Control	10.0	19.0	33.3	4.8	13.2	13.3
Salad Bar only	13.3	13.2	14.7	20.9	4.5	19.4
Mktg Only	11.5	41.5	12.7	44.7	41.5	9.0
Salad Bar +Mktg	11.7	20.3	15.4	28.1	18.9	19.3

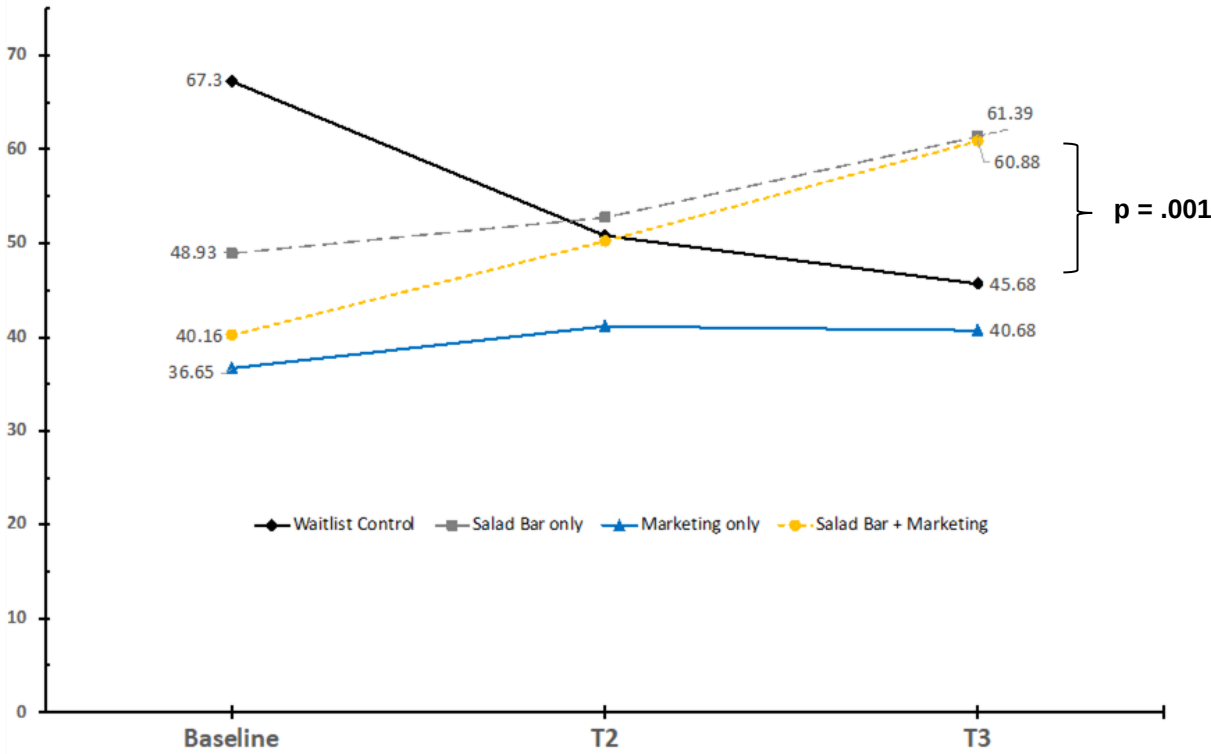


Elementary student findings

Any FV Consumption (vs none) by Intervention Condition over Time*



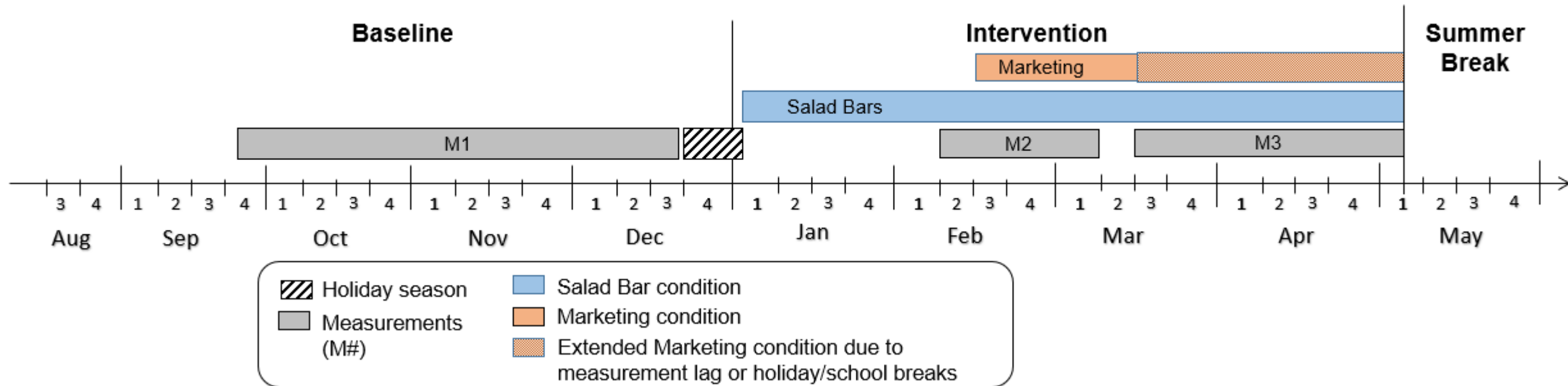
FV Consumption by Intervention Condition over Time * (N=3083)



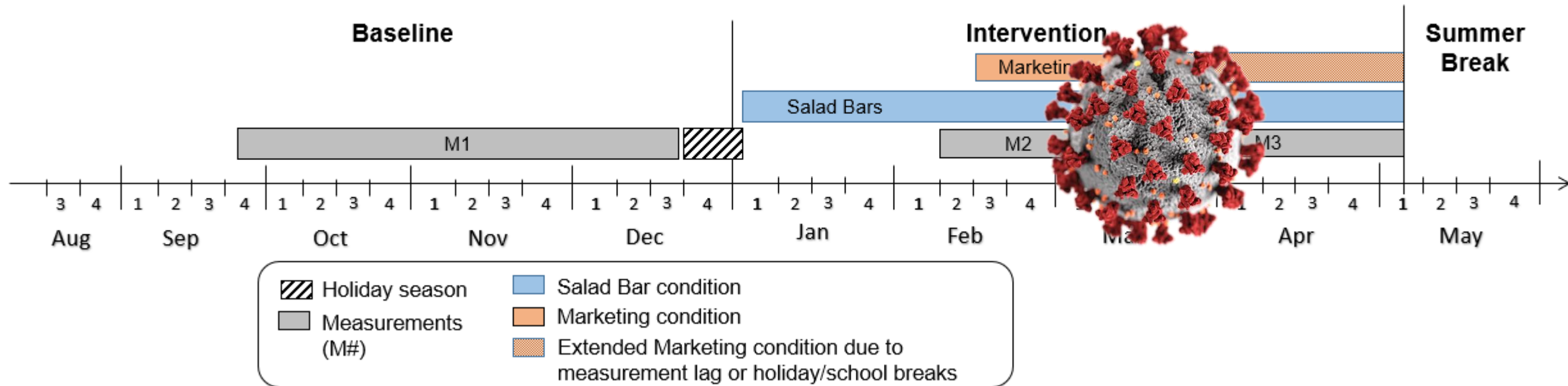
*Adjusting for covariates

Middle & High School Design

- Cluster RCT (N=24 schools; 12 middle and 12 high schools)



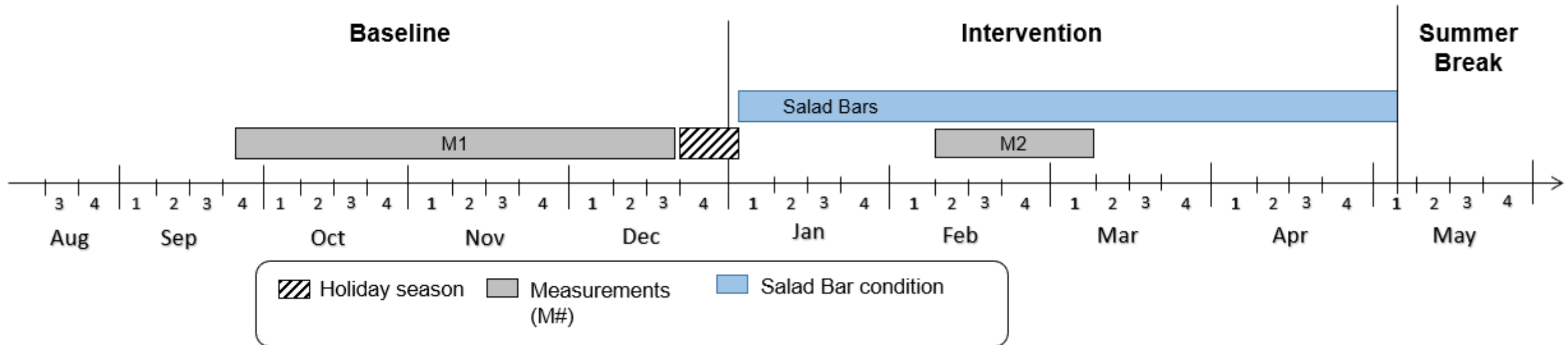
Design



→ 4 schools missing M2 + 14 schools missing M3

COVID Adapted Design

- Cluster RCT (N=20 schools)





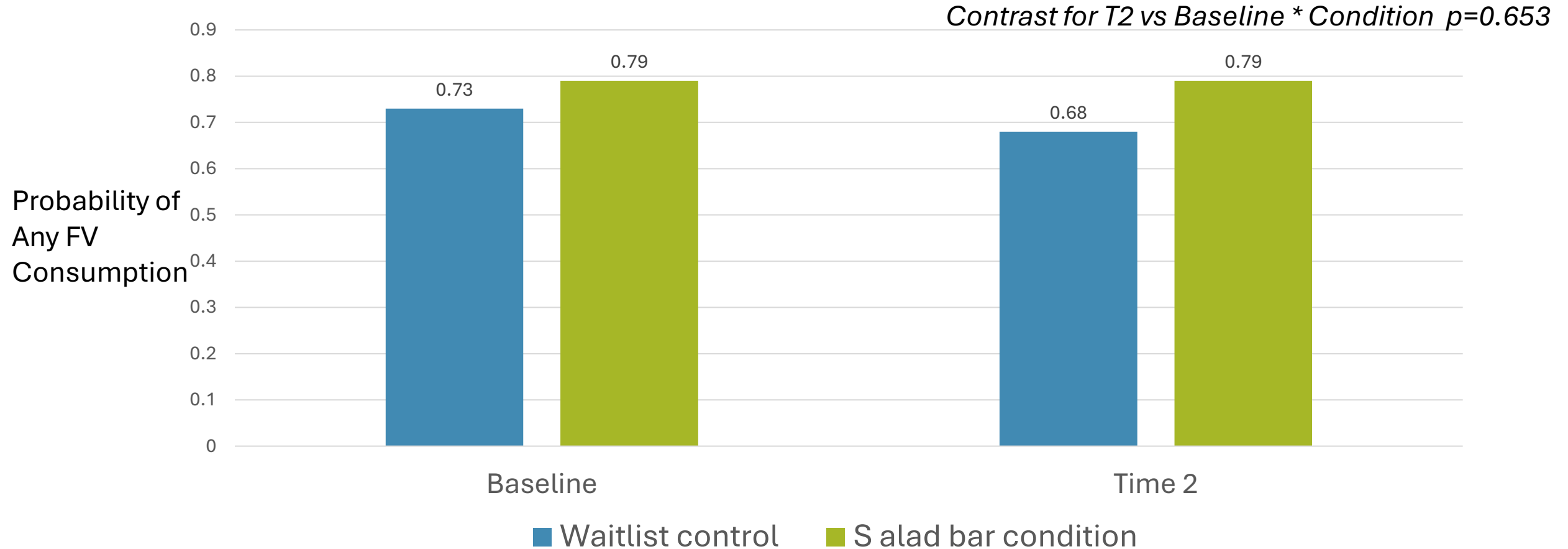
MS & HS student participants (N=3498)

Female, n (%)	1559 (45.0)
Race/ethnicity, n (%)	
Non-Hispanic White	878 (25.2)
Hispanic (any race)	2165 (62.1)
American Indian/Alaska Native	114 (3.3)
Asian/Pacific Islander	56 (1.6)
Black/African American	155 (4.4)
Other	121 (3.5)
Grade, n (%)	
6	498 (14.3)
7	581 (16.7)
8	559 (16.0)
9	516 (14.8)
10	487 (14.0)
11	453 (13.0)
12	395 (11.3)
Free/Reduced price lunch, n (%)	2688 (76.5)

MS and HS Observations with No FV Consumption and Salad Dressing Present

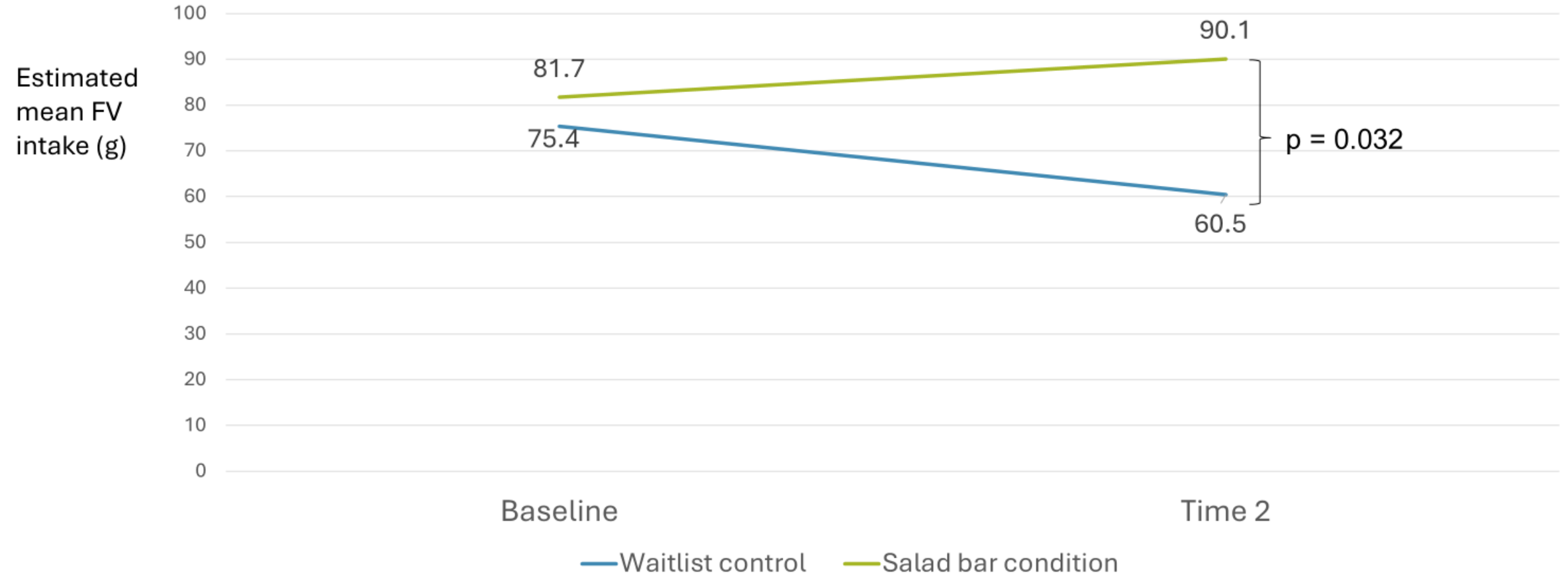
	% no FV consumption		% with salad dressing present	
	Baseline	Time 2	Baseline	Time 2
Control	33.8	33.5	37.9	42.0
Salad bar condition	29.0	29.5	18.9	22.8

Any FV Consumption (vs none) by Intervention Condition over Time*



*Adjusting for covariates

FV Consumption (g) by Intervention Condition over Time, among adolescents who ate any FVs



*Adjusting for covariates

Secondary analyses from baseline assessments

- Existing nutrition marketing in schools is not strong or designed with behavioral nutrition principles
- Rural and urban differences in FV consumption
 - Rural students (versus urban) had lower odds of selecting (OR=0.75), consuming (OR=0.78), and wasting (OR=0.71) any FVs
- Students loved and unloved items
 - Type of processing matters
- Differences in tray color
 - Lighter trays led to more consumption
- In progress:
 - Time to eat in relationship to FV consumption and waste
 - Weather impacts

Discussion

- First non-observational study on salad bars for middle and high school students
- The effect of SBs generalizes to adolescents in middle and high schools
 - Difference is equivalent to ~25 grams or 1/3 an apple or 7 baby carrots
- No change in proportion of adolescents who ate any FVs in either condition
- More is needed to promote:
 - Consumption once FVs are on the tray



Study Considerations

Limitations

- COVID impacted the original study design for MS and HS
- Schools in Arizona/US may not be generalizable to global context
- FVs measured in aggregate

Strengths

- Objective measures of individual consumption
- Large, diverse sample
- Random selection of students
- First RCT SB study with MS and HS students



Are salad bars an effective strategy for improving consumption?

YES

Possible next steps

- Nudge to encourage more FV consumption
- Leverage our plate waste and data systems
 - Setting
 - Schools (e.g., differences in scratch cooking, differences in farm-to-school)
 - Head Starts
 - University
 - Homes
 - Tie to biological/physiological outcomes
 - Develop AI to assess intake
- Examine nutrition security for youth with _____ outcome of interest

Thank you!

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Design and rationale for evaluating salad bars and students' fruit and vegetable consumption: A cluster randomized factorial trial with objective assessments

Journal of the Academy of Nutrition and Dietetics eat right.

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Use of Salad Bars in Schools to Increase Fruit and Vegetable Consumption: Where's the Evidence?

Open Access Article

Perceptions of Existing School Fruit and Vegetable Marketing Materials Targeted to School Students by School Nutrition Professionals and Youth

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