Title

Schools provided healthy meals even during COVID

Journal
California Agriculture, 77(3-4)

ISSN
0008-0845

Authors
Plank, Kaela
Linares, Amanda
Hewawitharana, Sridharshi C.
et al.

Publication Date
2023

DOI
10.3733/ca.2023a0012

RESEARCH ARTICLE

Schools provided healthy meals even during COVID

Students who ate more school meals during COVID consumed more fruits and vegetables, but also drank more sugary drinks.

by Kaela Plank, Amanda Linares, Sridharshi C. Hewawitharana and Gail Woodward-Lopez

Online: https://doi.org/10.3733/ca.2023a0012

Abstract

COVID-related school closures had a big impact on millions of children nationwide, many of whom rely on schools for healthy meals. An online survey of 3,297 fourth- and fifth-grade students in 67 California schools studied the dietary habits of schoolchildren during the pandemic. The results showed that students who ate one or two school meals a day had significantly higher intakes of vegetables, whole fruits, and 100% fruit juice, compared to students who did not eat school meals. Specifically, students who ate one school meal a day ate more beans and orange vegetables, while those who ate two school meals a day consumed a wider variety of vegetables, including beans and orange vegetables. However, children who ate one school meal a day drank more fruit drinks and flavored milks than those who did not eat school meals. Further, students who ate two school meals consumed more fruit drinks, flavored milks, and sports and energy drinks than those who did not eat school meals. Our findings suggest that, while school meals were an important source of fruits and vegetables during the pandemic, more needs to be done to reduce consumption of sugary drinks.

Nationwide, 30 million children participate in the National School Lunch Program (NSLP) and 15 million in the School Breakfast Program (SBP) (USDA Economic Research Service 2022; USDA Food and Nutrition Service 2019). These programs provide free or reduced-price meals (FRPM) to schoolchildren from households with incomes at or below 185% of the federal poverty level (FPL) (USDA Economic Research Service 2021; USDA Food and Nutrition Service 2019). The programs are required to meet nutrition standards consistent with the Dietary Guidelines for Americans (DGA) and are an important nutritional safety net for children living in households with lower incomes (Cullen and Chen 2017; USDA Food and Nutrition Service 2012). Participation in school meal programs improves student nutrition, school attendance, and academic achievement and increases food security (Anzman-Frasca et al. 2015; Au et al. 2018; Frisvold 2015; Huang and Barnidge 2016; Ralston et al. 2017).

In March 2020, schools closed abruptly due to COVID-19. Throughout emergency school closures,

Nutrition Policy Institute researchers found that students who ate school meals during the COVID-19 pandemic consumed more fruits and vegetables than those who did not eat school meals. However, school meal consumption was also associated with a higher intake of sugary drinks. *Photo*: monkeybusinessimages, iStock.

districts continued to provide school meals through grab-and-go, drive-up, and/or home delivery. Select schools within districts served as meal pick-up sites and were supported by partner agencies, including local food banks and pantries. Meals for students in the district could be picked up at any of these schools or other locations in the community (Kinsey et al. 2020; Plank et al. 2022; Tadayon 2020). Yet, during this time, school meal participation decreased significantly across the United States, and recovery to pre-pandemic participation levels has been challenged by supply chain issues (Food Research and Action Center 2022; USDA Food and Nutrition Service 2022b). Supply chain disruptions resulted in barriers to procuring foods in full compliance with school nutrition standards, which impacted the quality of meals and student diets overall (School Nutrition Association 2021a, 2021b; USDA Food and Nutrition Service 2022b; Zuercher et al. 2022).

Despite monumental efforts by schools to mitigate the effects of closures on student diet and food access, U.S. Department of Agriculture (USDA) waivers to facilitate meal procurement, and federal funding for school meals, studies show a rise in food insecurity compared to pre-pandemic levels and a decline in fruit and vegetable intake, while sugar-sweetened beverage (SSB) consumption remained high (Pierre et al. 2021; Schanzenbach 2020; Sharma 2020; USDA 2021; USDA 2022).

Improving child nutrition security and diet quality — in particular, increasing fruit and vegetable consumption and decreasing SSB consumption — is a priority of the California Department of Public Health's CalFresh Healthy Living Program (CDPH-CFHL), which is the Supplemental Nutrition Assistance Program–Education (SNAP-Ed) in California. This is accomplished through nutrition education and policy, systems, and environmental change interventions that promote healthy eating and increase access to healthy food (USDA 2016). Local health departments collaborate with schools where at least 50% of their student population is eligible for FRPM to implement CDPH-CFHL that targets these goals. CDPH-CFHL's prioritization of school-based programming makes it an ideal partner for ensuring that school meals meet dietary standards and student needs during school closures. To better inform CalFresh Healthy Living and similar programs' efforts, we aimed to (1) describe dietary intake of students attending CalFresh Healthy Living–eligible schools during school closures and (2) understand the association between school meal consumption and dietary intake during school closures.

Fourth- and fifth-graders surveyed

This cross-sectional study included fourth- and fifth-grade students attending 67 CalFresh Healthy Living–eligible schools and after-school programs in California. Local health department staff or trained researchers recruited 50 schools that were interested in participating in CalFresh Healthy Living and another 17 eligible schools that were not interested in participating in the program (Linares et al. 2022).

At each participating school, approximately 60 students from at least three classrooms were invited to take the survey prior to any implementation of CDPH-CFHL programming at the school. None of the students in this study had been exposed to CalFresh Healthy Living programming at the time of data collection. Parents and students could opt out of the survey. A total of 3,804 students were invited to participate in this evaluation. Of those, 507 students were excluded from analysis due to student opt-out (verbally or returned a signed opt-out form from their parent or guardian), or missing covariate, exposure, or outcome data.

This study was determined to be non-human-subjects research by the Institutional Review Board at UC Davis and exempt by the state of California's Committee for the Protection of Human Subjects.

Self-reported eating habits

The Eating and Activity Tool for Students was utilized to assess students' self-reported dietary behaviors and sociodemographic characteristics. (See online supporting information.) The survey was administered online in the classroom for students attending in person, or via Zoom for students attending school remotely, by trained local health department nutrition educators and/or classroom teachers from October 2020 to May 2021. To capture typical school-day dietary intake, survey administrators were directed to conduct surveys on a weekday that was not a Monday or the day after a weekday school holiday or break. Despite efforts to ensure protocol fidelity, 6.7% were administered or entered into the online survey tool on a Monday or day after a holiday. Sensitivity analyses were conducted to test for differences in exposure and dietary outcome variables by survey administration date. No significant

To understand the association between school meal consumption and dietary intake during school closures, the authors surveyed fourth- and fifth-grade students at 67 CalFresh Healthy Living–eligible schools and after-school programs in California. *Photo:* IPGGutenbergUKLtd, iStock.

differences were found (data not shown). Therefore, all surveys (*n* = 222) were kept in the final sample.

Dietary behavior assessments included whether and where students consumed school breakfast and/or lunch, and consumption frequencies for all fruits, vegetables, and beverages consumed on the previous day, regardless of location, source, or time of day. If the student consumed the school meal at home, that implies the meal was either picked up at a school that provided school meals or was delivered to the home. No questions were included in the survey regarding specifically how the school meal was obtained by the household. To measure consumption frequency, 15 dietary questions were adapted from the validated School Physical Activity and Nutrition (SPAN) survey, with minor changes to formatting and wording made only to improve readability (Penkilo et al. 2008; Thiagarajah et al. 2008). These 15 questions measured the following dietary components: starchy vegetables (one question on intake of corn, potatoes, and peas — excluding French fries, chips, and other fried potatoes), orange vegetables, salad and green vegetables, other vegetables, beans, fruit, 100% fruit juice, diet soda, fruit drinks, sports drinks, regular soda, energy drinks, sweetened coffee and tea, flavored milk, and water. Intake responses to questions about fruits and vegetables and SSBs were summed to derive the following additional outcome variables: total fruit, total fruit excluding 100% fruit juice, total vegetable (sum of starchy vegetable, orange vegetable, salad and green vegetable, other vegetable, and bean question responses), total SSBs (sum of fruit drinks, sports drinks, regular soda, energy drinks, sweetened coffee and tea, and flavored milk question responses), and total SSBs excluding flavored milk.

TABLE 1. Sample characteristics

Student demographics (*n* = 3,297)	Mean (SE) or *n* (%)
Age*	9.8 (0.05)
Grade†	
Fourth	2, 026 (61.5%)
Fifth	1,267 (38.5%)
Self-identified race/ethnicity	
American Indian/Alaskan Native	76 (2.3%)
Asian	147 (4.5%)
Black	266 (8.1%)
Latino	1,646 (49.9%)
Native Hawaiian/Pacific Islander	28 (0.8%)
White	546 (16.6%)
Other	45 (1.4%)
Multiple race/ethnicities	543 (16.5%)
Self-identified sex	
Female	1,706 (51.7%)
Male	1,591 (48.3%)
How student attended school	
Did not attend school yesterday	202 (6.1%)
In person	199 (6.0%)
Distance learning	2,750 (83.4%)
In person and distance learning	146 (4.4%)
School meals consumed yesterday	
Did not eat school breakfast or lunch meals	2,408 (73.0%)
Ate one school meal (breakfast or lunch)	392 (11.9%)
Ate two school meals (breakfast and lunch)	497 (15.1%)
School sociodemographics (*n* = 67)	
Racial/ethnic distribution of enrolled students (%)	
American Indian/Alaskan Native	0.3 (0.04)
Asian	3.8 (0.84)
Black	7.4 (1.22)
Filipino	1.8 (0.28)
Latino	71.1 (2.66)
Multiracial	2.7 (0.30)
Pacific Islander	0.5 (0.09)
White	11.6 (1.97)
Not reported	0.8 (0.14)
Student enrollment	537.2 (21.42)
Percent of students eligible for free or reduced-price meals (FRPM)	80.9 (1.62)

* Mean student age adjusts for clustering by school.

† A total of 3,313 students reported their grade.

Statistical analysis

Descriptive statistics were used to describe the student and school samples. Multilevel, Poisson regression using PROC GENMOD was used to assess the associations between number of school meals consumed in the past day and dietary intake frequencies. The models were adjusted for student-level age, race/ethnicity, sex, method of attending school in the past day, and site-level proportion of students eligible for FRPM, and accounted for clustering by site. Students with incomplete demographic (*n* = 434) or school meal consumption (*n* = 24) information were excluded from all analyses. Students missing information on all outcomes were also excluded (*n* = 20). A *P*-value of less than 0.05 was considered statistically significant. Analyses were performed in SASv9.4.

Diverse students surveyed

The overall analytic sample included 3,297 students from 67 CalFresh Healthy Living–eligible schools across California, and the final analytic samples ranged from 3,263 to 3,295 students due to missing responses in the outcomes of interest.

Students were, on average, 9.8 years old and 62% were in fourth grade. About half identified as female (52%) and half as Latino (50%) (table 1). Most students attended school by distance learning (83%) and 12% percent of students had eaten one school meal (either breakfast or lunch) in the past day, while 15% percent had eaten both school breakfast and lunch. There were statistically significant differences in self-identified race/ethnicity, sex, and method of school attendance on the previous day between students who did not eat school meals, those who ate one school meal, and those who ate two school meals (see online supporting information).

On average, 81% of students enrolled in the sampled schools were FRPM-eligible, based on pre-COVID school meal eligibility criteria, and sampled schools were mostly comprised of students identifying as Latino (mean percent 71.1%), followed by white (11.6%) and black (7.4%).

More fruits and vegetables

As table 2 shows, students on average ate fruit 2.4 ± 0.04 (mean ± SE) times per day (times/day), with 100% fruit juice accounting for 40% of intake. Students ate vegetables 3.2 ± 0.08 times/day. As table 3 shows, eating more school meals was associated with higher total fruit and vegetable consumption. Compared to students who did not eat school meals, the frequency of fruit consumption (excluding 100% fruit juice) was 20% greater (adjusted mean: 1.3 versus 1.6 times/day) for those who ate one school meal and 28% greater (1.3 versus 1.7 times/day) for those who ate two meals (table 2). School meals were also associated with increased consumption of 100% fruit juice; 26% (0.9 versus 1.1 times/day) for those who ate one school meal and 34% (0.9 versus 1.2 times/day) for those who ate two meals.

A similar trend was seen for total vegetables; consumption of one school meal was associated with a 13% higher vegetable consumption (adjusted mean: 3.0 versus 3.4 times/day), and two school meals was associated with a 30% higher vegetable consumption frequency (3.0 versus 3.9 times/day) compared to not eating school meals. Eating two school meals was associated with a higher consumption frequency across all measured vegetable components and one school meal was associated with higher bean and orange vegetable consumption frequencies.

More sugary drinks from schools

Overall, sampled students consumed SSBs 2.3 ± 0.05 times/day (mean± SE) with flavored milk accounting for much of that intake (table 3). School meal consumption was associated with a higher total SSB intake. Compared to students who did not eat school meals, SSB consumption frequency was 13% higher (adjusted mean: 2.5 versus 2.8 times/day) among those who ate one school meal and 30% higher (2.5 versus 3.1 times/day) among those who ate two school meals (table 2). Consumption of one or two school meals was associated with increased fruit drink and flavored milk intake. In addition to flavored milk and fruit drinks, consuming two school meals was associated with higher sports and energy drink consumption.

A vital source of nutrition

School meals provide about a third of a child's daily energy intake (Aranceta Bartrina and Pérez-Rodrigo 2006). Although the relationship between consumption of school meals and overall diet quality has been explored previously, findings have been mixed. We found that, with consumption of both one and two school meals, there was a higher intake of total fruits and total vegetables. This aligns with prior findings which showed that students who consumed school breakfast had higher Healthy Eating Index (HEI) scores for total and whole fruit, and higher fruit intake when school breakfast was consumed daily (Au et al. 2016; Au et al. 2018). Previous studies show mixed findings for vegetable intake and school meal types. One study found that school breakfast and lunch consumption was associated with higher HEI scores for total vegetables, while another study found no associations with school breakfast and lunch intake (Au et al. 2016; Hanson and Olson 2013). More recent findings show an association between school breakfast and vegetable and legume intake, but not for school lunch. (Au et al. 2016; Au et al. 2018). Unlike past research, our analysis did not consider school breakfast and lunch independently, which reduces comparability across studies. Nevertheless, despite added procurement challenges due to COVID-19, our results corroborate past findings indicating that school meals are associated with higher fruit intake and provide further evidence that school meals are positively associated with vegetable intake (Au et al.

TABLE 2. Average dietary intakes among sampled students

Dietary intakes (number of times drank/ate yesterday)	Whole sample (*n* = 67 schools)	
	***n* students**	**Mean (SE)***
Water	3,273	2.3 (0.02)
Total SSBs	3,263	2.3 (0.05)
SSBs, excluding flavored milk	3,264	1.7 (0.05)
Fruit drinks	3,273	0.7 (0.02)
Sports drinks	3,269	0.3 (0.01)
Regular soda	3,274	0.4 (0.02)
Energy drinks	3,270	0.1 (0.01)
Sweetened coffee/tea drinks	3,272	0.3 (0.01)
Flavored milk/milk-type drinks	3,273	0.6 (0.02)
Total fruit	3,292	2.4 (0.04)
Fruit, excluding 100% juice	3,295	1.5 (0.03)
100% fruit juice	3,293	0.9 (0.02)
Total vegetables	3,286	3.2 (0.08)
Potatoes/corn/peas	3,294	0.7 (0.02)
Orange vegetables	3,294	0.6 (0.02)
Salad/green vegetables	3,292	0.8 (0.02)
Other vegetables	3,294	0.8 (0.02)
Beans	3,293	0.4 (0.02)

* Standard errors adjusted for clustering of students by school.

TABLE 3. Adjusted means and associations between number of school meals consumed and dietary intake frequency in the past day

Dietary intakes (number of times drank/ate yesterday)	Did not eat any school meals			Ate one school meal				Ate both school breakfast and lunch			
	n schools	*n* students	Adjusted mean (95% CI)	*n* schools	*n* students	Adjusted mean (95% CI)	IRR*	*n* schools	*n* students	Adjusted mean (95% CI)	IRR*
Water	64	2,393	2.3 (2.18,2.36)	60	389	2.3 (2.17,2.43)	1.01	64	491	2.2 (2.11,2.33)	0.98
Total SSBs	64	2,388	2.5 (2.31,2.69)	60	388	2.8 (2.45,3.25)	**1.13**	64	487	3.1 (2.74,3.45)	**1.23**
SSBs, excluding flavored milk	64	2,388	1.9 (1.74,2.09)	60	389	2.1 (1.80,2.46)	1.11	64	487	2.3 (2.04,2.63)	**1.21**
Fruit drinks	64	2,393	0.7 (0.60,0.75)	60	389	0.8 (0.67,0.94)	**1.19**	64	491	0.9 (0.74,1.02)	**1.30**
Sports drinks	64	2,390	0.3 (0.26,0.38)	60	389	0.4 (0.28,0.46)	1.13	64	490	0.4 (0.34,0.51)	**1.32**
Regular soda	64	2,393	0.4 (0.39,0.51)	60	389	0.4 (0.30,0.47)	0.86	64	492	0.4 (0.38,0.52)	1.01
Energy drinks	64	2,393	0.1 (0.10,0.18)	60	389	0.2 (0.12,0.28)	1.35	64	488	0.2 (0.14,0.31)	**1.56**
Sweetened coffee/tea drinks	64	2,391	0.3 (0.25,0.36)	60	389	0.4 (0.27,0.48)	1.20	64	492	0.3 (0.26,0.42)	1.11
Flavored milk/milk-type drinks	64	2,393	0.6 (0.50,0.64)	60	388	0.7 (0.58,0.80)	**1.20**	64	492	0.7 (0.62,0.85)	**1.29**
Total fruit	64	2,406	2.2 (2.03,2.45)	61	390	2.7 (2.47,3.02)	**1.22**	65	496	2.9 (2.61,3.21)	**1.30**
Fruit, excluding 100% juice	64	2,408	1.3 (1.18,1.48)	61	390	1.6 (1.40,1.80)	**1.20**	65	497	1.7 (1.50,1.90)	**1.28**
100% fruit juice	64	2,406	0.9 (0.81,1.00)	61	391	1.1 (1.02,1.27)	**1.26**	65	496	1.2 (1.07,1.35)	**1.34**
Total vegetables	64	2,403	3.0 (2.68,3.30)	60	388	3.4 (2.92,3.89)	**1.13**	65	495	3.9 (3.43,4.39)	**1.31**
Potatoes/corn/peas	64	2,407	0.7 (0.56,0.75)	60	391	0.7 (0.62,0.90)	1.15	65	496	0.9 (0.73,0.99)	**1.31**
Orange vegetables	64	2,407	0.5 (0.44,0.57)	61	390	0.6 (0.53,0.76)	**1.26**	65	497	0.7 (0.64,0.84)	**1.47**
Salad/green vegetables	64	2,405	0.8 (0.66,0.85)	61	390	0.8 (0.65,0.92)	1.03	65	497	1.0 (0.85,1.18)	**1.33**
Other vegetables	64	2,407	0.7 (0.64,0.81)	61	390	0.8 (0.67,0.92)	1.09	65	497	0.9 (0.77,1.00)	**1.22**
Beans	64	2,406	0.3 (0.25,0.38)	61	391	0.4 (0.28,0.49)	**1.21**	65	496	0.4 (0.29,0.49)	**1.23**

* The incident rate ratio (IRR) was derived from multilevel, Poisson regression, adjusting for student age, race/ethnicity, sex, and method of attending school the past day, school proportion of students eligible for free- and reduced-price meals, and accounting for clustering by school. "Did not eat any school meals" category was used as the reference group for comparisons. Bold font indicates significance at $P < 0.05$. Example IRR interpretation for Total SSBs: The average number of times total SSBs were consumed was 1.13 times higher (IRR = 1.13) among students who ate one school meal compared to those that did not eat any school meals.

2016; Hanson and Olson 2013). Lastly, our findings on fruit and vegetable intake are encouraging because they align with the DGA recommendation to consume a variety of vegetables (USDA and U.S. Department of Health and Human Services 2020) and highlight how the federal nutrition policies outlined in the Healthy, Hunger-Free Kids Act may have positively impacted student diet (Healthy, Hunger-Free Kids Act 2010).

Concern about sweet drinks

Our findings also suggest that there remains room for improvement in fruit and vegetable intake, thereby highlighting the ongoing need for programs like CalFresh Healthy Living to support fruit and vegetable access in schools and promote fruit and vegetable consumption among students and their families. Particularly for fruit intake, current recommendations promote whole fruit over 100% juice and encourage limiting juice intake to 8 ounces per day (Heyman et al. 2017). In this sample, fruit juice represented over 40% of fruit intake, suggesting a need to support and encourage schools to offer and promote whole fruit consumption over fruit juice.

SSBs contribute significantly to total added sugar intake for children (Bailey et al. 2018; CDC 2022). In our sample, students consumed SSBs 2.3 times/day. This is considerably higher than the average of one SSB, or 143 calories per day, previously reported for children 2 to 19 years old (Rosinger et al. 2017). Consumption of over two SSBs (286 calories from added sugar) daily would likely contribute to sugar intake that exceeds the DGA recommendation to limit added sugar to less than 10% of total daily energy, which is 1,400–2,600 calories for 9- to 13-year-olds (USDA and U.S. Department of Health and Human Services 2020).

While flavored milk is an allowable beverage to serve with elementary school meals (USDA Food and Nutrition Service 2022a), we classify it as an SSB in this study because it can contain up to twice as much sugar as white milk (Hahn et al. 2022; NYC Health Center for Health Equity n.d.). National School Lunch Program participants often select nonfat flavored milk as their beverage of choice (Bergman et al. 2016), which may explain the observed association between school meals and flavored milk consumption. Furthermore, during school closures, the USDA released a meal pattern flexibility waiver, removing the requirement that schools offer at least two milk types with school meals (USDA Food and Nutrition Service 2020). Due to supply chain disruptions and/or student preference, schools may have only offered flavored milk with school meals, eliminating students' ability to choose a white milk option. Past studies have shown that removing flavored milk from school meals reduces sugar intake with minimal impact on overall milk consumption (Thompson et al. 2020). Given that almost three-quarters of SSB consumption in our sample was attributed to flavored milk, removing flavored milk or, at a minimum, ensuring white milk access during school closures, may protect against excessive sugar intake. Additional studies should evaluate how milk type availability during emergency school closures impacts flavored milk and total sugar intake. Given the health benefits of reducing sugar intake, programs like CalFresh Healthy Living can support schools through promoting white milk consumption among students and working with school nutrition services to ensure white milk is the default option.

The observed association between fruit drink consumption and school meals is inconsistent with the literature indicating school lunch eaters drink fewer fruit drinks than students who do not eat school lunch (Johnston et al. 2012). Misclassification error of fruit drinks may explain our counterintuitive findings. Studies show that children struggle to use and comprehend nutrition labels (Brierley and Elliott 2015; Lytle et al. 1997), which may affect students' ability to accurately discern between 100% fruit juice and fruit drinks. Since only 100% fruit juice, and not fruit drinks, qualifies as a fruit serving for federally reimbursable school meals, it is unlikely that schools would knowingly offer fruit drinks with meals (USDA Food and Nutrition Service 2012). Furthermore, fruit drinks do not meet California Education Code beverage standards, which govern competitive sale of beverages on campus (California Education Code 2001). These standards may influence food service decisions for all beverage procurement, further reducing the likelihood that fruit drinks would be offered with school meals. The observed correlation might be due to differences in fruit drink availability at home or other neighborhood settings between students who consumed school meals and those who did not. Unmeasured factors such as the home environment may also explain the observed associations between school meal consumption and increased intake of energy and sports drinks. Further research is needed to understand the types of beverages offered with school meals and at home during school closures and the subsequent impact on beverage consumption. While school support to ensure adherence to standards when providing grab-and-go meals may be helpful, education for students and their caregivers about the dietary impacts of SSB consumption may also be effective at reducing consumption of sugar-sweetened fruit drinks.

Snapshot in time

Our study had some limitations. First, it was a cross-sectional study, rather than a study of change over time, and thus does not allow for causal inferences. Second, convenience sampling was used, thus limiting the generalizability of the findings. Furthermore, dietary measures were self-reported by children and only measured one day of intake, which may not be representative of a child's typical diet. However, questions used to assess dietary intake were validated among fourth-graders (Penkilo et al. 2008; Thiagarajah et al. 2008). Additionally, the specific foods provided with school meals and from other settings are unknown, limiting our ability to attribute differences to a given source. This may be particularly true for the observed associations for fruit, sports, and energy drinks. Further, only a fraction (27%) of our sample ate school meals during this time, perhaps due to the increased difficulty of obtaining school meals during school closures and distance learning (Cadenhead et al. 2022; Plank et al. 2022). This may have reduced the power of our study to detect statistically significant differences between students who did not eat school meals and those who ate one or two school meals. Despite the small sample size, we still observed significant associations between school meal consumption and increased intake of fruits and vegetables, further exemplifying how important school meals are for improving dietary intake. While these results are only generalizable to students attending CalFresh Healthy Living–eligible schools in California and may not be representative of California students as a whole, nearly 60% of California public school students are currently FRPM eligible (California Department of Education 2021), making these findings especially relevant from a health equity standpoint.

Preparing for future closures

To our knowledge, this study is one of the first to assess the association between school meals and dietary intake during COVID-19-related school closures. Our findings corroborate previous research that school meals make an important contribution to children's consumption of fruits and vegetables. However, our study also identified a correlation between increased school meal consumption and higher consumption of SSBs, thereby highlighting the potential opportunity for improvement. There is

Almost three-quarters of sugar-sweetened beverage consumption in the authors' sample was attributed to flavored milk, which can contain up to twice as much sugar as white milk. Removing flavored milk, or ensuring white milk access during school closures, may protect against excessive sugar intake. *Photo:* og-vision, iStock.

Nearly 60% of California public school students are eligible for free or reduced-priced meals. Studies show that participation in school meal programs improves student nutrition, school attendance, and academic achievement. *Photo:* BRPH, iStock.

still much to learn about how children's diets changed during COVID-19. Some of the unknowns include whether the dietary quality of school meals changed significantly with the adoption of grab-and-go style meals, how children's eating habits changed when dining away from school, and how foods available to them at home impacted overall diet.

Despite these unknown factors, it is reasonable to assume that students' abilities to attend school in person and eat healthy meals on site may again be challenged for a variety of health and safety reasons. To ensure that future emergencies do not exacerbate health disparities among students, schools need to be prepared to offer nutritious meals despite these challenges. This study identified areas for improvement that can help guide future interventions implemented by CalFresh Healthy Living and similar programs. These programs can help support schools during emergency closures by continuing to educate students and their families about nutrition and the risks of consuming SSBs; building partnerships throughout the community to ensure access to healthier beverages; providing professional training and logistical support to school nutrition services to ensure that white milk, not sweetened drinks, is the default beverage for school meals; and, in the event of supply chain challenges, fostering schools' ability, in conjunction with partners and other stakeholders, to independently procure food that meets school meal standards. CA

K. Plank is Evaluation Specialist, Nutrition Policy Institute, UC ANR; A. Linares is Senior Evaluation Specialist, Nutrition Policy Institute, UC ANR; S.C. Hewawitharana is Research Data Analyst, Nutrition Policy Institute, UC ANR; G. Woodward-Lopez is Associate Director of Research, Nutrition Policy Institute, UC ANR.

This study would not have been possible without the commitment and hard work of our local health department partners, and the school/after-school sites that participated in this evaluation. We also thank Evan Talmage, Phoebe Harpainter, and Ron Strochlic for their roles in recruitment of school sites.

This study was conducted as part of a contract with the California Department of Public Health with funding from the United States Department of Agriculture (USDA) Supplemental Nutrition Assistance Program (SNAP). These institutions are equal opportunity providers and employers. The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views or opinions of the California Department of Public Health or the California Health and Human Services Agency.

References

Anzman-Frasca S, Djang HC, Halmo MM, et al. 2015. Estimating impacts of a breakfast in the classroom program on school outcomes. JAMA Pediatr 169(1):71–7. https://doi.org/10.1001/jamapediatrics.2014.2042

Aranceta Bartrina J, Pérez-Rodrigo C. 2006. Resources for a healthy diet: School meals. Brit J Nutr 96 Suppl 1:S78–81. https://doi.org/10.1079/bjn20061705

Au LE, Gurzo K, Gosliner W, et al. 2018. Eating school meals daily is associated with healthier dietary intakes: The Healthy Communities Study. J Acad Nutr Diet 118(8):1474–81.e1. https://doi.org/10.1016/j.jand.2018.01.010

Au LE, Rosen NJ, Fenton K, et al. 2016. Eating school lunch is associated with higher diet quality among elementary school students. J Acad Nutr Diet 116(11):1817–24. https://doi.org/10.1016/j.jand.2016.04.010

Bailey RL, Fulgoni VL, Cowan AE, Gaine PC. 2018. Sources of added sugars in young children, adolescents, and adults with low and high intakes of added sugars. Nutrients 10(1):102. https://doi.org/10.3390%2Fnu10010102

Bergman EA, Englund T, Ogan D, et al. 2016. Beverage selections and impact on healthy eating index scores in elementary children's lunches from school and from home. J Child Nutrition and Management 40(1).

Brierley M, Elliott C. 2015. Nutritional components and children's interpretations of packaged food. Int J Health Promotion and Education 53(5):230–43. https://doi.org/10.1080/14635240.2015.1010654

Cadenhead JW, McCarthy JE, Nguyen TTT, et al. 2022. Qualitative study of participation facilitators and barriers for emergency school meals and pandemic electronic benefits (P-EBT) in an urban setting during COVID-19. Nutrients 14(16):3358. https://doi.org/10.3390/nu14163358

California Department of Education. 2021. CDE Student Poverty FRPM data, 21–22 School Year. https://dq.cde.ca.gov/dataquest/Cbeds1.asp?FreeLunch=on&cChoice=StatProf1&cYear=2021-22&cLevel=State&cTopic=FRPM&myTimeFrame=S&submit1=Submit

California Education Code. 2001. Article 2.5. The Pupil Nutrition, Health, and Achievement Act of 2001 [49430 - 49434]. https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=49431.5.&lawCode=EDC

[CDC] Centers for Disease Control and Prevention. 2022. Get the Facts: Sugar-Sweetened Beverages and Consumption. www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages-intake.html

Cullen KW, Chen TA. 2017. The contribution of the USDA school breakfast and lunch program meals to student daily dietary intake. Prev Med Rep 5:82–5. https://doi.org/10.3945/jn.112.170548

Food Research and Action Center. 2022. The Reach of Breakfast and Lunch: A Look at Pandemic and Pre-Pandemic Participation. https://frac.org/wp-content/uploads/SchoolMealsReport2022.pdf

Frisvold DE. 2015. Nutrition and cognitive achievement: An evaluation of the School Breakfast Program. J Public Econ 124:91–104. https://doi.org/10.1016/j.jpubeco.2014.12.003

Hahn S, Hill A, Maroney M. 2022. Behind the Carton: 2022 School Milk Report. www.cspinet.org/sites/default/files/2022-12/CSPI_SchoolMilkReport2022_BTC3.pdf

Hanson KL, Olson CM. 2013. School meals participation and weekday dietary quality were associated after controlling for weekend eating among U.S. school children aged 6 to 17 years. J Nutr 143(5):714–21. https://doi.org/DOI:10.3945/jn.112.170548

Healthy, Hunger-Free Kids Act of 2010. 2010. Pub. L. No. 111-296, 124 Stat. 3183 www.congress.gov/bill/111th-congress/senate-bill/3307

Heyman MB, Abrams SA, et al. 2017. Fruit juice in infants, children, and adolescents: Current recommendations. Pediatrics 139(6):e20170967. https://doi.org/10.1542/peds.2017-0967

Huang J, Barnidge E. 2016. Low-income children's participation in the National School Lunch Program and household food insufficiency. Soc Sci Med 150:8–14. https://doi.org/10.1016/j.socscimed.2015.12.020

Johnston CA, Moreno JP, El-Mubasher A, Woehler D. 2012. School lunches and lunches brought from home: A comparative analysis. Child Obes 8(4):364–8. https://doi.org/10.1089/chi.2012.0012

Kinsey EW, Hecht AA, Dunn CG, et al. 2020. School closures during COVID-19: Opportunities for innovation in meal service. Am J Public Health 110(11):1635–43. https://doi.org/10.2105%2FAJPH.2020.305875

Linares A, Harpainter P, Plank K, Woodward-Lopez G. 2022. Lessons learned recruiting comparison elementary schools for impact evaluation of SNAP-Ed interventions. J Extension 60(2):Article 17. https://doi.org/10.34068/joe.60.02.17

Lytle LA, Eldridge AI, Kotz K, et al. 1997. Children's interpretation of nutrition messages. J Nutr Educ 29(3):128–36. https://doi.org/https://doi.org/10.1016/S0022-3182(97)70177-8

NYC Health Department Center for Health Equity. n.d. Choose Plain Milk, Not Chocolate Milk, for Your School. www1.nyc.gov/assets/doh/downloads/pdf/dpho/chocolate-milk-guide.pdf (accessed 2022).

Penkilo M, George GC, Hoelscher DM. 2008. Reproducibility of the school-based nutrition monitoring questionnaire among fourth-grade students in Texas. J Nutr Educ Behav 40(1):20–7. https://doi.org/10.1016/j.jneb.2007.04.375

Pierre CS, Guan W, Merrill J, et al. 2021. Changes in dietary intake during COVID-19 among youth in urban communities: Insights from the COACHES study. Current Developments in Nutrition 5(Supplement 2):184. https://doi.org/10.1093/cdn/nzab035_092

Plank K, Hewawitharana S, Talmage E, et al. 2022. School meal access and changes in meal participation during COVID-19 school closures: A stratified random sample of CalFresh Healthy Living Eligible school districts in California. Prev Med Reports 28:101794. https://doi.org/10.1016/j.pmedr.2022.101794

Ralston K, Treen K, Coleman-Jensen A, Guthrie J. 2017. Children's Food Security and USDA Child Nutrition Programs. USDA Economic Information Bulletin 174. www.ers.usda.gov/webdocs/publications/84003/eib-174.pdf?v=7187.8

Rosinger A, Herrick K, Gahche J, Park S. 2017. Sugar-sweetened beverage consumption among U.S. youth, 2011–2014. NCHS Data Brief 2017 Jan(271):1–8.

Schanzenbach DW. 2020. Not ENOUGH TO EAT: COVID-19 Deepens America's Hunger Crisis. Food Research and Action Center. https://frac.org/wp-content/uploads/Not-Enough-to-Eat_Hunger-and-COVID.pdf

School Nutrition Association. 2021a. 2021 Supply Chain Survey Report. https://schoolnutrition.org/resource/2021-supply-chain-survey-report/

School Nutrition Association. 2021b. Back to School 2021 Report. https://schoolnutrition.org/resource/back-to-school-2021-report/

Sharma SV, Chuang R-J, Rushing M, et al. 2020. Social determinants of health-related needs during COVID-19 among low-income households with children. Prev Chronic Dis 17:200322. https://doi.org/10.5888/pcd17.200322

Tadayon A. 2020. California food banks partner with schools to serve families of students. EdSource. https://edsource.org/2020/california-food-banks-partner-with-schools-to-serve-families-of-students/627322

Thiagarajah K, Fly AD, Hoelscher DM, et al. 2008. Validating the food behavior questions from the elementary school SPAN questionnaire. J Nutr Educ Behav 40(5):305–10. https://doi.org/10.1016/j.jneb.2007.07.004

Thompson HR, Ritchie L, Park E, et al. 2020. Effect of removing chocolate milk on milk and nutrient intake among urban secondary school students. Prev Chronic Dis 17:200033. https://doi.org/10.5888/pcd17.200033

U.S. Census Bureau. (nd). QuickFacts: California. www.census.gov/quickfacts/CA

[USDA] U.S. Department of Agriculture. 2016. SNAP-Ed Toolkit: Obesity Prevention Interventions and Evaluation Framework. https://snapedtoolkit.org/framework/index/ (accessed April 16, 2022).

USDA. 2021. USDA Distributes $1.5 Billion to Strengthen School Meal Program. www.usda.gov/media/press-releases/2021/12/17/usda-distributes-15-billion-strengthen-school-meal-program

USDA. 2022. California: COVID-19 Waivers and Flexibilities. www.fns.usda.gov/disaster/pandemic/covid-19/california#cn (accessed Jan. 19, 2022).

USDA and U.S. Department of Health and Human Services. 2020. Dietary Guidelines for Americans, 2020–2025. www.DietaryGuidelines.gov

USDA Economic Research Service. 2022. School Breakfast Program. www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/school-breakfast-program/

USDA Food and Nutrition Service. 2012. Final Rule: Nutrition Standards in the National School Lunch and Breakfast Programs. www.federalregister.gov/documents/2012/01/26/2012-1010/nutrition-standards-in-the-national-school-lunch-and-school-breakfast-programs

USDA Food and Nutrition Service. 2019. National School Lunch Program (NSLP) Fact Sheet. www.fns.usda.gov/nslp/nslp-fact-sheet (accessed Jan. 27, 2022).

USDA Food and Nutrition Service. 2020. CN – Allow Meal Pattern Flexibility in SFSP and SSO – Extension 7. www.fns.usda.gov/cn/covid-19-child-nutrition-response-53

USDA Food and Nutrition Service. 2022a. National School Lunch Program Meal Pattern. https://fns-prod.azureedge.us/sites/default/files/resource-files/nslp-meal-pattern-chart-2022.pdf (accessed May 2022).

USDA Food and Nutrition Service. 2022b. Results of tFNS-Administered School Food Authority Survey on Supply Chain Disruption. tinyurl.com/2p99e8vk

Valle GR. 2022. *Gardening at the Margins: Convivial Labor, Community, and Resistance*. University of Arizona Press. 240 p.

van Dorn A, Cooney RE, Sabin ML. 2020. COVID-19 exacerbating inequalities in the US. Lancet 395(10232):1243–4. https://doi.org/10.1016/S0140-6736(20)30893-X

Vitiello D. 2022. "The highest and best use of land in the city": Valuing urban agriculture in Philadelphia and Chicago. J Agr Food Syst Commun Dev 11(3):1–8. https://doi.org/10.5304/jafscd.2022.113.019

White MM. 2011. Sisters of the soil: Urban gardening as resistance in Detroit. Race/Ethnicity: Multidisciplinary Global Contexts 5(1):13–28. https://doi.org/10.2979/racethmulglocon.5.1.13

Zuercher MD, Cohen JFW, Hecht CE, et al. 2022. Providing school meals to all students free of charge during the COVID-19 pandemic and beyond: Challenges and benefits reported by school foodservice professionals in California. Nutrients 14(18):3855. https://doi.org/10.3390/nu14183855