

**Evaluation Report  
BUSD Network for a Healthy California 2007-2008**

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## INTRODUCTION

The Berkeley Unified School District (BUSD) Network for a Healthy California (*Network*) Program provides cooking and gardening classes for all public schools in Berkeley that qualify for their services by having 50% or more students eligible for free or reduced lunch. The University of California Dr. Robert C. & Veronica Atkins Center for Weight and Health (CWH) was contracted to evaluate the effects of these cooking and gardening classes on food behavior, specifically on consumption of fruits and vegetables during lunch time.

For the BUSD Network evaluation, CWH gathered information to assess food preferences and behaviors among 5<sup>th</sup> graders in two *Network*-funded schools. In particular, it assessed:

- Preferences for fruits and vegetables
- Types of fruits and vegetables available for lunch (from school or home)
- Amounts and types of fruits and vegetables consumed during lunch

In addition to *Network* sponsored cooking and gardening activities, the BUSD also has changed the school food system for the entire district under the Berkeley School Lunch Initiative (SLI) – healthy and fresh food, including salad bars are now available to all students. The SLI is a system-wide change in food service accompanied by educational components in the regular classroom. Support from the Chez Panisse Foundation through the Berkeley School Lunch Initiative Evaluation Study and UC Berkeley allowed for these same data to be gathered from 5<sup>th</sup> graders at two non-*Network* funded schools in Berkeley to allow for comparisons.

In addition, consumption data are reported here on students from the four schools from the SLI evaluation, using information and analysis of food diaries. (More information on the SLI evaluation and methods are available from the CWH.)

### Study Design for BUSD Network for a Healthy California Evaluation

By the 4<sup>th</sup> and 5<sup>th</sup> grades, children in Berkeley schools with *Network* funded programs have been exposed to extensive cooking, gardening and nutrition education offered at these schools for many years. This evaluation study assessed differences in preferences for selected fruits and vegetables, and foods consumed at lunch between children receiving *Network* funded programs and those not receiving them. (*Network* funding was used to gather data from *Network* funded schools, and funds from the Chez Panisse Foundation and UC Berkeley were used to gather data from non-*Network* funded schools.)

## METHODS

### Overview

Generally, two types of data were gathered: food preference and food behavior. To assess *food preference*, the *Network* questionnaire was adapted to include featured Harvest of the Month fruits and vegetables– asparagus, apples, broccoli, butternut squash, carrots,

mandarins, persimmons, salad greens, and tomatoes; as well as fruits and vegetables that had not been featured as Harvest of the Month item — green beans, kiwi, spinach, and sweet potatoes.

To assess *food behavior*, data were gathered in two ways: (a) photographs of foods eaten at lunch in school; and (b) 3-day food diaries, which were analyzed to estimate changes in intake of fruit and vegetables over a year. A total of 133 4<sup>th</sup> and 5<sup>th</sup> grade students agreed to participate in this study with 75 from *Network* schools and 58 from non-*Network* schools; 117 students agreed to have their foods photographed and had complete data for analysis of consumption during lunch time.

### **Fruit and vegetable preferences**

The adapted Network questionnaire was administered to 133 5<sup>th</sup> graders of whom 75 were from two *Network* supported schools, and 58 from two non-*Network* schools using resources available through the BUSD Berkeley School Lunch Initiative. The questionnaires were administered during lunch time, either before students began eating while photographs were being taken of their food, or while they were eating. Students filled in the questionnaires themselves with trained staff available to answer questions and review questionnaires for completeness.

### **Fruit and vegetable consumption**

To gather fruit and vegetable consumption data, photographs were taken of the lunches of all participating 5<sup>th</sup> graders (and some 4<sup>th</sup> graders where classes were mixed 4-5<sup>th</sup> grades), regardless of whether the lunches were brought from home or served by the school, before they began eating, and again after the students had finished eating. Sixteen trained college student volunteers assisted with taking these photographs during a total of two lunch periods at the four schools. A protocol was developed for estimating amount consumed of various foods with a focus on fruits and vegetables.

Additional data on fruit and vegetable consumption are available from the Berkeley School Lunch Initiative (SLI), which gathered 3-day food diaries during the months of January-March. These data were obtained from 153 students in the 4<sup>th</sup> grade in 2006-2007, and then again the following year (from the same students). One-year changes in fruit and vegetable consumption were compared between two *network* schools and two non-*Network* schools.

## **RESULTS**

### **Characteristics of participants**

Gender and ethnic distributions of the students are shown in Tables 1A and 1B. They did not differ between Network and non-Network schools.

**Table 1A: Gender distribution of Network evaluation participants**

Network		Non-Network	
Males	<b>36 (48%)</b>	Males	<b>30 (52%)</b>
Females	<b>39 (52%)</b>	Females	<b>28 (48%)</b>
Total	<b>75</b>	Total	<b>58</b>

**Table 1B: Racial and Ethnic distribution of Network evaluation participants\***

	Network		Non-Network		Total
	Hispanic/ Latino	Non-Hispanic/ Latino	Hispanic/ Latino	Non-Hispanic /Latino	
American Indian/ Alaska Native	-	-	-	-	-
Asian	-	6	-	10	16
African American	-	22	-	12	34
Native Hawaiian/ Pacific Islander	-	-	-	-	-
White	16	16	7	18	57
More than One Race	-	10	-	9	19
Don't know	-	7	-	6	13
<b>Total</b>	16	61	7	55	139

\* Racial and ethnic data are taken from one question that asked about ethnicity and race, without distinguishing Hispanics of different races. However, given reporting requirements for demographic data for most federal programs, we followed protocols from previous research and assumed children marked Hispanic / Latino only were White Hispanic / Latino.

### **Fruit and Vegetable Preferences**

Preferences for specific fruit and vegetables were gathered using an adapted Network for a Healthy California survey, and analyzed using *Network* scoring methods so that responses include 2 (do not like), 3 (like a little) or 4 (like a lot). Responses marked “not familiar” were excluded from the analysis; therefore, the preference responses reported here are among students familiar with the fruit or vegetable. Data from the Network questionnaire suggest that preference for fruits and preference for vegetables were higher among students at *Network* schools than among students from non-*Network* schools ( $p < .05$ ) Further analysis shows that preferences for specific vegetables and fruits show statistically significant differences for those fruits and vegetables featured in *Network* lessons (Table 3).

**Table 2: Average Scores for Fruit and Vegetable Preferences from the Network for a Healthy California Survey<sup>a,b</sup>**

Schools	Fruit Preference <sup>**</sup>	Vegetable Preference <sup>*</sup>
<i>Network</i>	3.39	3.30
<i>Non-Network</i>	3.15	3.09

<sup>a</sup> Scores are based on a 2-4 point scale (4="like alot" 3="like a little" 2="do not like")

<sup>b</sup> Scores are adjusted for race

<sup>\*</sup> Significantly different between Network and non-Network schools at p<.05 (evaluated using ANCOVA)

<sup>\*\*</sup> Significantly different between Network and non-Network schools at p<.01 (evaluated using ANCOVA)

**Table 3: Average Scores for Preferences for specific fruits and vegetables**

Food Item	<i>Network</i>	<i>Non-Network</i>
Asparagus <sup>*</sup>	2.92	2.53
Apples	3.87	3.87
Broccoli	3.32	3.30
Squash <sup>**</sup>	2.88	2.13
Carrots <sup>*</sup>	3.69	3.45
Green Beans	3.36	3.33
Kiwi	3.57	3.51
Mandarins	3.53	3.42
Persimmons <sup>**</sup>	3.51	2.79
Salad greens	3.37	3.42
Spinach	3.04	3.10
Sweet potatoes	3.51	3.34
Tomatoes <sup>*</sup>	3.52	3.21

<sup>a</sup> Scores are based on a 2-4 point scale (4="like alot" 3="like a little" 2="do not like")

<sup>b</sup> Scores are adjusted for race

<sup>\*</sup>Significantly between Network and non-Network schools at p<.05 (adjusted for race/ethnicity; evaluated using ANCOVA)

<sup>\*\*</sup>Significantly between Network and non-Network schools at p<.0001 (adjusted for race/ethnicity; evaluated using ANCOVA)

### **Fruit and vegetable consumption at lunch: Analysis of Photographs**

Analysis of photographs of students' lunches involved examination of food available for consumption before children began eating, food left after they finished eating, and calculating the difference to estimate amounts consumed. Amounts were calculated using a scoring system based on surface area, and comparing surface area for reference plates with known quantities. This method was developed for this study, and may need significant refinement for amounts to be reliable; however, there is no reason for systematic bias that would make the amounts estimated vary according to any variable of interest, such as *Network* status. Therefore while absolute amounts may not be reliable and should be interpreted appropriately, relative amounts and comparisons between groups have no basis for systematic error.

Findings from the analysis of photographs show higher fruit and vegetable consumption among students eating school lunches compared to those bringing lunch from home, and higher fruit and vegetable consumption among students at *Network* schools (Table 4).

More specifically, analysis of the photographs reveals the following differences in fruit and vegetable consumption between students in *Network* schools and students in non-*Network* schools (Table 4):

- Before the children ate, children at *Network* schools had more vegetables on their plates (1.81 cups) than those at non-*Network* schools (0.78 cups), a statistically significant difference.
- Students at *Network* schools ate more vegetables, although this difference was not statistically significant (0.96 cups versus 0.75 cups)
- The proportion of vegetables eaten was higher at non-*Network* schools, meaning that students at non-*Network* schools who had vegetables ate nearly all of the vegetables on their plates, while students at *Network* schools ate about 70% of the vegetables on their plates. This difference was statistically significant.
- There was no significant difference found in fruit consumption during lunch between students at *Network* and non-*Network* schools. The average amount on the plates before eating was virtually identical at over 0.8 cups, and students ate nearly all of the fruit that was available to them.
- Comparing school lunches with lunches brought from home found significant differences in vegetables available and vegetables consumed in this context, with all schools offering healthier school lunches, cooking and gardening classes being offered at *Network* schools, and other elements of the School Lunch Initiative. **Among schools participating in the School Lunch Initiative, students who ate school lunch consumed over 3 times as many vegetables as children who brought lunch from home.**

Racial/ethnic differences in fruit and vegetable consumption were observed but few reached statistical significance.

These findings should be interpreted cautiously. It is to be especially noted that rates of school lunch consumption are higher at *Network* schools (Table 5); statistical analysis was not able to distinguish between the effects of school lunch offering more vegetables and the effects of *Network* program participation. However, analysis of the food diaries gathered by the Berkeley SLI evaluation shows higher fruit and vegetable consumption both in and out of school among students at *Network* schools (see next section for more details), suggesting that the program may have positive effects on food behavior outside of school hours.

**Table 4: Vegetable and fruit consumption by school *Network* status, lunch source, and race**

Subgroup	N	VEGETABLES			FRUIT		
		Amount available for consumption <sup>a</sup>	Amount consumed <sup>a</sup>	Proportion consumed <sup>b</sup>	Amount available for consumption <sup>a</sup>	Amount consumed <sup>a</sup>	Proportion consumed <sup>b</sup>
<b>By <i>Network</i> status:</b>							
<i>Network</i>	66	1.81 ± 1.93 <sup>1</sup>	0.96 ± 1.25	0.69 ± 0.36 <sup>2</sup>	0.83 ± 1.07	0.75 ± 0.99	0.94 ± 0.21
<i>Non-Network</i>	51	0.78 ± 1.42 <sup>1</sup>	0.75 ± 1.40	0.96 ± 0.19 <sup>2</sup>	0.84 ± 0.90	0.83 ± 0.90	0.98 ± 0.06
<b>By lunch source:</b>							
Ate school lunch	56	2.32 ± 1.97 <sup>3</sup>	1.36 ± 1.47 <sup>3</sup>	0.75 ± 0.34	0.65 ± 0.90	0.64 ± 0.89	0.99 ± 0.06
Lunch from home	61	0.47 ± 1.01 <sup>3</sup>	0.42 ± 0.97 <sup>3</sup>	0.88 ± 0.28	1.01 ± 1.06	0.92 ± 0.98	0.95 ± 0.19
<b>By race:</b>							
Asian	10	1.56 ± 1.96	1.29 ± 1.87	0.88 ± 0.25	1.00 ± 1.05	1.00 ± 1.05	1.00 ± 0.00 <sup>4</sup>
Black	29	0.89 ± 1.28	0.64 ± 1.06	0.85 ± 0.30	0.94 ± 1.04	0.92 ± 1.03	0.98 ± 0.08
Latino	19	2.09 ± 2.14	0.91 ± 1.26	0.63 ± 0.45	0.80 ± 0.92	0.80 ± 0.92	1.00 ± 0.00
White	32	0.90 ± 1.48	0.66 ± 1.20	0.82 ± 0.31	0.77 ± 0.87	0.74 ± 0.85	0.96 ± 0.14
Mixed	15	2.24 ± 2.32	1.63 ± 1.83	0.78 ± 0.28	0.90 ± 1.11	0.90 ± 1.11	1.00 ± 0.00 <sup>5</sup>
Other/unknown	12	1.32 ± 1.70	0.61 ± 0.57	0.72 ± 0.35	0.59 ± 1.26	0.25 ± 0.62	0.67 ± 0.58 <sup>4,5</sup>

<sup>a</sup> standard cup equivalents

<sup>b</sup> Proportion calculated for only those who had vegetables (or fruit) available for consumption

<sup>c</sup> Significant differences are indicated by similar numeral superscripts:

<sup>1</sup> Significantly different between *network* and *non-network* schools at p<.01

<sup>2</sup> Significantly different between *network* and *non-network* schools at p<.001

<sup>3</sup> Significantly different between school lunch and lunch brought from home at p<.0001

<sup>4,5</sup> Significantly different between races at p<.05

**Table 5: Distribution of students by school lunch vs. lunch brought from home<sup>a</sup>**

	<i>Network</i> Schools (N=66)	<i>Non-Network</i> schools (N=51)
School lunch	41 (62.1%)	15 (29.4%)
Lunch brought from home	25 (37.9%)	36 (70.6%)

<sup>a</sup> Proportions differed between network and non-Network schools at p<.001 ( $\chi_{df=1}^2 = 12.33$ )

### Comparison of food consumption behavior from *Network* and *Non-Network* Schools using data from the School Lunch Initiative (SLI) Evaluation

In addition to the data collected on students' lunch time consumption, this report was able to draw on findings from the larger SLI evaluation being conducted by CWH at the same 4 elementary schools where photography and questionnaire data were collected. The School Lunch Initiative has four components, including many changes in school lunch (including salad bars in all schools), curriculum integration, and cooking and gardening classes funded in eligible schools by the Network for a Healthy California. This larger evaluation study, which began collecting data in the Spring of 2007 from over 300 4<sup>th</sup> and 5<sup>th</sup> graders, involves obtaining food diaries for three consecutive weekdays, once a year

for 3 years. These 3-day food diary data have been analyzed to compare consumption of fruits and vegetables in 2007, as well as *changes* in consumption from 2007 to 2008, between students at *Network* and non-*Network* schools. (More details on the data collection and analysis methods are available from CWH.)

The findings indicate differences in consumption changes from 2007 to 2008. Specifically, while no differences in consumption of fruits and vegetables were observed between students in *Network* schools and students in non-*Network* at baseline in 2007, there were observable differences in the *change* in consumption of fruits and vegetables from 2007 to 2008. Most strikingly, while on average, consumption of fruit and vegetables decreased by 0.20 servings among students at the non-*Network* schools, consumption of fruits and vegetables *increased by 0.26 servings* among students at *Network* schools (Table 6).

These changes in consumption from the first to the second year of the SLI evaluation may indicate the impact of *Network* supported activities. Further, this association may be especially noteworthy since the *Network* schools have proportionately more low-income students than the non-*Network* schools. The findings from the Network and School Lunch Initiative evaluation datasets, examining students' food preferences, the proportion of fruits and vegetables consumed by students at lunch, and fruit and vegetable consumption in and out of school, suggest that students at *Network* schools are consuming more fruits and vegetables. However, other differences between schools may contribute to the differences in fruit and vegetable consumption that we observed.

In summary:

- Analysis of food diary data from the SLI evaluation shows that students in the two *Network* elementary schools report greater increases in fruit and vegetable consumption over one year than students in the non-*Network* schools.
- Students from *Network* schools report eating more fruit both in and out of school, and more vegetables during school.
- Students from *Network* schools also report eating more seasonal fruits and vegetables.
- Details on amounts and findings are contained in Tables 6 – 8.

**Table 6: Average daily consumption of fruits and vegetables from food diaries<sup>1,2</sup>**

	Mean consumption <sup>1</sup> (cups/d), N=153	
	<i>Network</i>	<i>Non-Network</i>
<b>Daily fruit servings</b>		
Spring 2007 (4 <sup>th</sup> grade)	1.15	1.21
Spring 2008 (5 <sup>th</sup> grade)	1.42 <sup>b</sup>	1.01 <sup>b</sup>
Change between 2007 and 2008	0.26 <sup>c</sup>	-0.20 <sup>c</sup>
<b>Daily vegetable servings</b>		
Spring 2007 (4 <sup>th</sup> grade)	0.88	0.94
Spring 2008 (5 <sup>th</sup> grade)	1.36 <sup>d</sup>	0.91 <sup>d</sup>
Change between 2007 and 2008	0.48 <sup>c</sup>	-0.03 <sup>e</sup>
<b>Daily fruit and vegetable servings</b>		
Spring 2007 (4 <sup>th</sup> grade)	2.03	2.14
Spring 2008 (5 <sup>th</sup> grade)	2.77 <sup>c</sup>	1.92 <sup>c</sup>
Change between 2007 and 2008	0.74 <sup>d</sup>	-0.22 <sup>d</sup>

<sup>1</sup> Estimated from food diaries using servings of foods consumed.

<sup>2</sup> Adjusted for race, and parent/guardian education.

<sup>a-d</sup> Differences between *Network* schools and non-*Network* schools were evaluated using least square means; significant differences at p<0.05 are indicated by matching superscripts

<sup>e</sup> Differences between *Network* schools and non-*Network* schools were evaluated using least square means; significant differences at p<0.20 are indicated by matching superscripts

**Table 7: Average daily consumption of seasonal fruits and vegetables from food diaries<sup>1,2,3</sup>**

	Mean consumption <sup>1</sup> (cups/d), N=153	
	<i>Network</i>	<i>Non-Network</i>
<b>Daily seasonal fruit servings</b>		
Spring 2007 (4 <sup>th</sup> grade)	0.09	0.12
Spring 2008 (5 <sup>th</sup> grade)	0.35	0.30
Change	0.26	0.18
<b>Daily seasonal vegetable serving</b>		
Spring 2007 (4 <sup>th</sup> grade)	0.28	0.35
Spring 2008 (5 <sup>th</sup> grade)	0.68 <sup>*</sup>	0.43 <sup>*</sup>
Change	0.40 <sup>*</sup>	0.08 <sup>*</sup>
<b>Daily seasonal fruit and vegetable servings</b>		
Spring 2007 (4 <sup>th</sup> grade)	0.37	0.47
Spring 2008 (5 <sup>th</sup> grade)	1.03 <sup>†</sup>	0.72 <sup>†</sup>
Change	0.66 <sup>*</sup>	0.26 <sup>*</sup>

<sup>1</sup> Estimated from food diaries using servings of foods consumed.

<sup>2</sup> Adjusted for race, and parent/guardian education.

<sup>3</sup> Seasonal produce (list for San Francisco Bay Area derived from <http://www.localfoodswheel.com/> (Gosselin, Klein, Prentice, 2006) for January – April months).

\*† Pairwise differences between groups at *Network* vs non-*Network* schools were evaluated using least square means; significant differences at p<0.05 are indicated by matching superscript (\*), significant differences at p<0.10 are indicated by matching superscript (†)

**Table 8: Average daily consumption of food groups eaten outside of and during school hours from food diaries<sup>1,2,3</sup>**

	Mean consumption <sup>1</sup> (cups/d) N=153			
	<i>Outside school hours</i>		<i>During school hours</i>	
	<i>Network</i>	<i>Non-Network</i>	<i>Network</i>	<i>Non-Network</i>
<b>Daily fruit servings</b>				
Spring 2007 (4 <sup>th</sup> grade)	0.55	0.62	0.44	0.56
Spring 2008 (5 <sup>th</sup> grade)	0.76	0.53	0.61	0.43
Change	0.21 <sup>a</sup>	-0.09 <sup>a</sup>	0.16 <sup>b</sup>	-0.13 <sup>b</sup>
<b>Daily vegetable servings</b>				
Spring 2007 (4 <sup>th</sup> grade)	0.58	0.61	0.22	0.32
Spring 2008 (5 <sup>th</sup> grade)	0.77	0.70	0.54 <sup>c</sup>	0.17 <sup>c</sup>
Change	0.19	0.09	0.32 <sup>d</sup>	-0.16 <sup>d</sup>
<b>Daily fruit and vegetable servings</b>				
Spring 2007 (4 <sup>th</sup> grade)	1.13	1.23	0.66	0.89
Spring 2008 (5 <sup>th</sup> grade)	1.53	1.23	1.15 <sup>e</sup>	0.60 <sup>e</sup>
Change	0.40	-0.00	0.49 <sup>f</sup>	-0.29 <sup>f</sup>

<sup>1</sup> Estimated from food diaries using servings of foods consumed.

<sup>2</sup> Adjusted for race and parent/guardian education.

<sup>3</sup> Estimated from mealtimes reported in food diaries, compared to individual school bell schedules

<sup>a-f</sup> Differences between *Network* and non-*Network* schools were evaluated using least square means; significant differences at p<0.05 are indicated by matching superscripts

## CONCLUSIONS AND SUMMARY

Analysis of a questionnaire designed to assess food preferences, photographs of foods eaten during lunch, and reports from 3-day food diaries suggest a positive effect of *Network* activities on children's fruit and vegetable consumption. To summarize the findings:

### **Consumption of fruits and vegetables: Examining Photographs of Students' Lunches**

- Analysis of the photography data comparing school lunches with lunches brought from home found significant differences in vegetables available and vegetables consumed in this context, with all schools offering healthier school lunches, cooking and gardening classes being offered at *Network* schools, and other elements of the School Lunch Initiative. **Among schools participating in the School Lunch Initiative, students who ate school lunch consumed over 3 times as many vegetables as children who brought lunch from home.**
- **NOTE:** Because more students at *Network* schools ate school lunch than students at non-*Network* schools (69% at *Network* schools versus 29% at non-*Network* schools), statistical analysis could not distinguish between the impact of *Network* activities alone and the impact of eating school lunch alone without also receiving *Network* activities, given the small sample size. Further research using larger and weighted samples would allow this issue to be explored further.
- Students at *Network* schools had more vegetables on their plates than those at non-*Network* schools before they began eating, a statistically significant difference.
- Students at *Network* schools consumed more vegetables (nearly 1 cup at *Network* schools versus roughly  $\frac{3}{4}$  cup at non-*Network* schools), although this difference was not statistically significant.
- There was no difference found in fruit consumption during lunch between students at *Network* and non-*Network* schools. The average amount on the plates before eating was virtually identical at over 0.8 cups, and students ate nearly all of the fruit on their plates.

### **Data from 3-day food diaries comparing intake of students over 2 years confirm higher consumption of fruits and vegetables among students at *Network* schools**

- Data from the 3-day food diaries show a strong and statistically significant pattern over time. **Most strikingly, while consumption of fruit and vegetables declined by about  $\frac{1}{4}$  cup among students at the non-*Network* schools between 2007 and 2008, consumption increased among students at *Network* schools by about  $\frac{3}{4}$  cup, a statistically significant difference.**
- Students from *Network* schools reported eating more fruit both in and out of school, and more vegetables during school, and students from *Network* schools also reported eating more seasonal fruits and vegetables.

Overall, differences found in vegetable consumption during lunch, and changes in consumption over time from food diaries indicate continuing differences in consumption between students at *Network* schools and students at non-*Network* schools, possibly indicating the impact of *Network* supported activities. It should also be noted that positive changes in the consumption of fresh

fruits and vegetables seen at the Network schools may have a greater impact on the nutritional status of BUSD students given that proportionately more low income children, who tend to have lower intakes of fresh fruits and vegetables, are enrolled at the Network schools.

## **RECOMMENDATIONS**

Our findings suggest that Network school activities may have a positive impact on the food behavior of the students. However, due to the relatively small sample size and the use a newly developed unvalidated photographic method for estimating amounts of various foods eaten, it is important that we conduct a repeat analysis to confirm these findings with next year's data. If confirmed, there could be important policy implications for the National School Lunch program, which targets school-aged children.