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## Influencing healthful food choices in school and home environments: Results from the TEENS study

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### Abstract

**Background.** The purpose of this research is to examine the effects of an intervention designed to increase the availability of fruits, vegetables and lower fat foods in homes and schools. This research is part of the TEENS study, a school-based intervention study.

**Methods.** Sixteen schools in Minnesota were recruited to be in the study, and approximately 3600 middle school students in the eight intervention schools were exposed to a multi-component intervention. The TEENS intervention included classroom-based curricula, family newsletters, and changes in the school food environment including increasing more healthful options on a la carte and on the school lunch line. In addition to student-level outcomes, changes in availability of fruits, vegetables, and lower fat snacks in home and school environments were evaluated. The TEENS study was conducted from 1997 to 2000.

**Results.** Parents of students in intervention schools reported making healthier choices when grocery shopping as compared to parents of students in control schools ( $P = 0.01$ ). No intervention effects were evident from a home food inventory. Compared to control schools, intervention schools offered ( $P = 0.04$ ) and sold ( $P = 0.07$ ) a higher proportion of healthier foods on a la carte, but no effects were seen for fruit and vegetables sales as part of the regular meal pattern lunch.

**Conclusion.** Our results show mixed results for positively influencing adolescents' school and home environments.

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**Keywords:** Middle school environment; School food environment; Intervention; Competitive foods; Parents; Adolescents

### Background

American youth are falling short of achieving Healthy People 2010 goals for healthful dietary intakes (USDHHS, 2000, 1999; Krebs-Smith et al., 1996; Munoz et al., 1997; Cavadini et al., 2000). In recent years, we have begun to

consider eating patterns using a social–ecological framework, recognizing that the social and physical environments of families, schools, and communities all have important roles to play in what youth choose to eat (Sallis and Owen, 2002; Story et al., 2002a; Kubik et al., 2005; Wardle et al., 2005; Bogden and Vega-Matos, 2000; CDC, 1996).

Effective environmental change strategies have been emphasized as key in improving the eating behaviors and dietary intakes of youth (Stettler, 2002; Booth et al., 2001; IOM, 2005). However, there have been few studies with published results reporting on environmental-level efforts (French et al., 2004; Perry et al., 2004; French, 2003; Sallis et al., 2003). Teens Eating for Energy and Nutrition at School (TEENS) was a randomized school-based intervention trial conducted in middle schools with a goal of developing and

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evaluating school and family-linked intervention strategies to promote students' consumption of fruit, vegetable, and lower fat snacks (FVLFS); these results are presented elsewhere (Lytle et al., 2004). Environmental outcomes were evaluated as secondary outcomes of the study. The purpose of this paper is to describe the results of the TEENS intervention on school and family-level nutrition environments including the effectiveness of the intervention to positively influence the (1) availability of FVLFS in families' homes; (2) snack food selections made by families at the grocery store; (3) fruit, vegetable, and salad sales occurring in school cafeterias; and (4) the proportion of lower fat and healthier items offered and sold in a la carte lines.

## Methods

### Study design

Data for the present analyses are from school and parental data obtained from TEENS. TEENS was conducted in 16 schools in Minneapolis/St. Paul, Minnesota, and targeted schools with a lower income population (Lytle and Perry, 2001; Birnbaum et al., 2002). After meeting recruitment criteria, schools were randomly assigned from within matched pairs to intervention or control (delayed intervention) conditions. The study was reviewed and approved by the University of Minnesota Institutional Review Board for the protection of human subjects. Baseline data were collected in Fall 1998; a 2-year school-based intervention followed. Follow-up data on the cohort of students, the school, and families were obtained in Spring 2000. The students represented in TEENS were primarily white (72.9%), and 19.8% were categorized as lower socioeconomic status based on qualifying for free and reduced lunch and parental education and occupation (Lytle et al., 2004).

### TEENS intervention

The TEENS intervention included classroom, family, school policy, and food service components (Lytle and Perry, 2001; Birnbaum et al., 2002; Story et al., 2002b). A brief description of the family and school-level components follow as the effectiveness of these elements are examined in this manuscript.

Families of students enrolled in the TEENS class received three newsletters and sets of behavioral coupons with each newsletter for each year of the intervention (Lytle and Perry, 2001). The newsletters included a short lead article, tip sheets for eating more FVLFS, and sets of behavioral coupons. These coupons had simple, specific messages such as, "Buy pretzels instead of potato chips the next time you shop". Families received gift certificates for completing and mailing in coupons.

The school-level environmental strategies involved School Nutrition Advisory Councils (SNACs) and working with school food service. SNACs were established to convene school and parental stakeholders to discuss and propose school-level policy to improve the school food environment (Kubik et al., 2001). The composition of SNACs differed slightly school-to-school but included, as a minimum, a school administrator, food service staff, teacher, student, and university staff member.

The emphasis of the school food service intervention was on increasing the offerings and sales of FVLFS in the lunchroom and on the a la carte lines. District food service directors and workers from intervention schools attended trainings that emphasized the importance of offering more FVLFS, gave them new tools for promoting FVLFS, exposed food service workers to snacks and beverages that could be offered on the a la carte line that met the TEENS fat criteria of less than 5 g of fat per serving, including taste testing of lower fat products, and offered a forum for sharing ideas between schools. TEENS interventionists also conducted on-site trainings to help workers problem-solve.

## Measures

### Parent survey

Due to financial constraints, we conducted a post-only survey on a randomly chosen subsample of parents. In total, 526 families received, via mail, the TEENS parent survey in the spring of the 8th grade intervention year.

The parent survey included a 43-item home shelf inventory (Crockett et al., 1992) that asked the respondent parent to indicate if they had specific food items in their home at the time that they completed the survey. The parent survey also included nine paired responses, asking "If you had to choose between the following paired items in the grocery store, which would you buy?" The pairs were based on the TEENS behavioral coupons used in the family intervention component that gave suggestions for substituting lower fat choices for higher fat choices when shopping.

### School food environment/fruits, vegetables, and salads

Data on the fruits, vegetables, and salads available on school cafeteria lunch lines were collected at eight time points: baseline (fall 1998), six interim time points; and at follow-up (spring 2000). Each data point included 5 consecutive days of meal information. Data collected included the total number of students served the meal pattern lunch, the types and amounts of fruit and vegetable choices offered and sold, and the number of vegetable salads sold. With a few exceptions, these data were abstracted from schools' food production records. Periodic observations of school meals were conducted to confirm production records.

### School food environment/a la carte

For the purpose of TEENS, we defined a la carte as any foods or beverages that were available in the cafeteria and not offered as part of the meal pattern lunch. Guided by earlier work conducted on a la carte in schools (Harnack et al., 2000) and our intervention goals, we developed a daily data collection form for a la carte items that categorized a la carte items and documented the number of items offered and sold in each category.

At baseline and follow-up, TEENS evaluation staff observed and recorded all the foods and beverages that were offered and sold on a la carte lines for a 5-day period. Two evaluation staff conducted independent reviews of the data categorization and abstraction for data quality assurance. We summarized data into categories of "Foods to Promote" and "Foods to Limit". "Foods to Promote" included snacks that were 5 or less g of fat, 100% fruit juice, water and low fat milk, fruits or vegetables offered, and other lower fat versions of popular entrees such as pizza or pretzels and cheese. "Foods to Limit" included all snacks that were more than 5 g of fat, fruit drinks, and higher fat popular entrees such as regular pizza or nachos.

Table 1

The effect of the TEENS intervention on the home food environment

Home shelf inventory	Mean number of items reported in the house at the time of the post treatment survey		Difference by condition/ <i>P</i> value *
	Intervention	Control	
High fat items (range = 0–15)	9.08	9.00	Difference = 0.08 <i>P</i> = 0.39
Fruits (range = 0–14)	6.84	6.50	Difference = 0.34 <i>P</i> = 0.16
Vegetables (range = 0–14)	9.41	9.24	Difference = 0.17 <i>P</i> = 0.32
Shopping pairs	Mean number of lower fat choices from shopping pairs		Difference = 0.47 <i>P</i> = 0.01
	Intervention	Control	
Lower fat option favored in pair (range = 0–9)	4.73	4.26	

TEENS Study, Minneapolis, Minnesota, 1997–2000 (*n* = 343).

\* *P* values based on a one-tailed test of significance.

Data analysis

Parent survey

We calculated a score for the home shelf inventory. We used mixed model analysis of covariance (ANCOVA) (Murray, 1998) using SAS PROC MIXED, Version 6.12 to examine the effects of the intervention. We modeled demographics and condition as a fixed effect (intervention versus control) and school and residual error as nested random effects. The intervention effect was estimated as the adjusted mean difference between the intervention and control conditions and assessed against the variation among the schools nested within each condition, with 1 and 14 df.

School food environment/fruits, vegetables, and salads

For each time point, 5 days of data per school were averaged to provide one observation per school or eight observations per condition. These categories were

used as levels of time in a repeated ANOVA comparing patterns over time in the intervention and control conditions. In addition, the seven data points post-baseline were scaled in months to reflect time since baseline data collection. A linear random coefficients analysis was conducted to test whether there was a difference in linear trend over time between the intervention and control conditions.

School food environment/a la carte

Thirteen of the sixteen TEENS schools (5 control and 8 intervention) had a la carte lines. The primary analysis involved comparing the proportion of items from the “Foods to Limit” and “Foods to Promote” categories that were offered and sold between baseline and the follow-up time point. The analysis used was ANCOVA using PROC GLM.

A one-tailed test of significance was used in interpreting all analyses since we hypothesized that our intervention would result in more favorable outcomes as compared to the control condition.

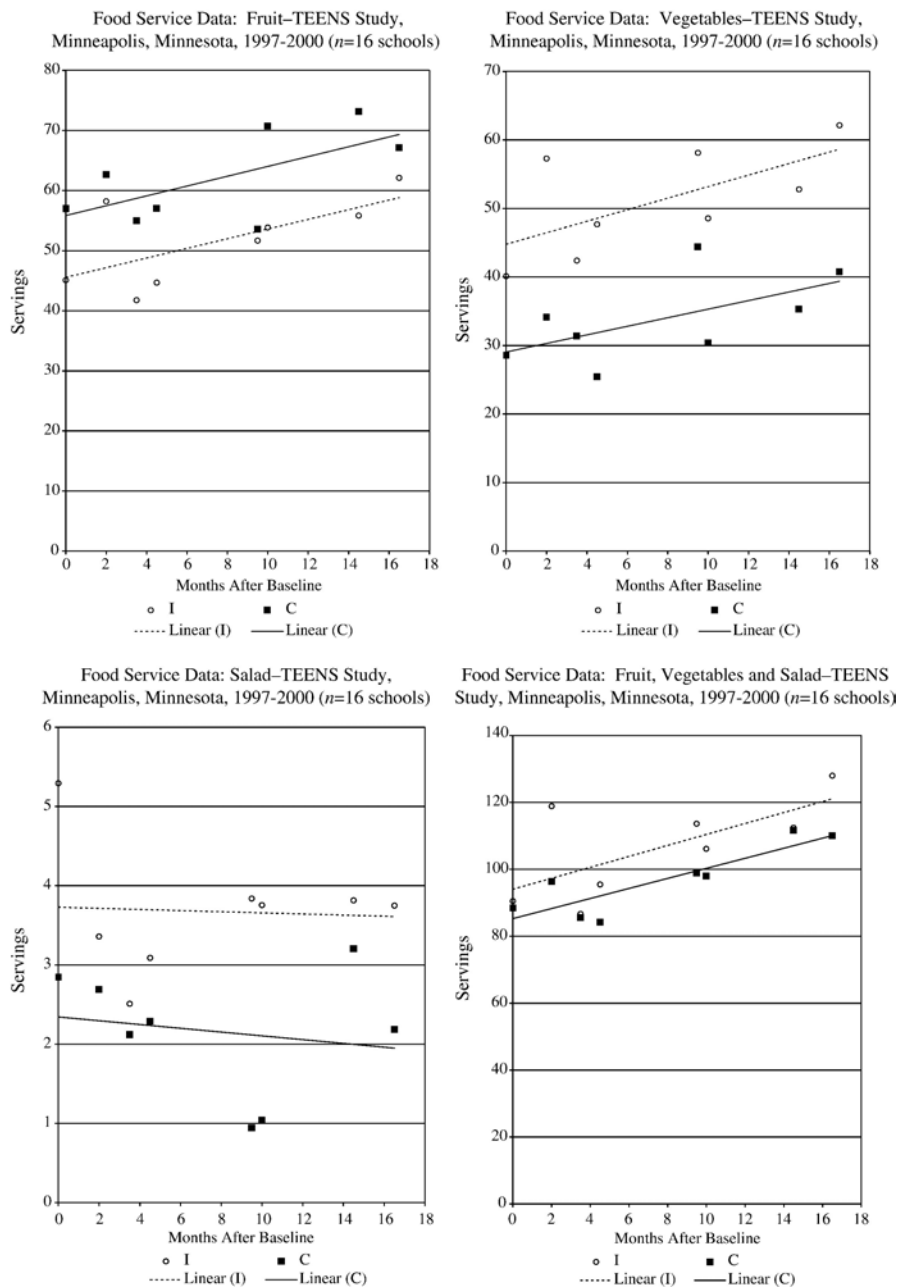


Fig. 1. Results from school food environment: sales of fruits, vegetables, salads, and all combined. Servings are scaled to represent number of servings per 100 meal pattern lunches served.

## Results

### Family-based outcomes

#### Sample for the parent survey

About two-thirds (67%;  $n = 343$ ) of families receiving the parent survey completed the survey. Participation did not differ significantly by treatment condition or by student-level dietary variables. Parental respondents were primarily the mother or female guardian of the randomly selected TEENS student (84% of respondents), 24% had a high school education or less, and 38% had graduated from college or had professional training beyond a 4-year college degree. Nearly 69% of family respondents were working full-time.

#### Parent survey results/home shelf inventory and shopping choices

There was no statistically significant difference by treatment condition for the home shelf inventory (Table 1). Parents whose children received the TEENS intervention reported being more likely to select the lower fat choice from the shopping pairs as compared to parents of children who did not receive the TEENS intervention ( $P = 0.01$ ).

### School environmental outcomes

#### Regular meal pattern lunch/fruits, vegetables, and salads

For the food groupings examined, there were no significant intervention effects, either in the repeated measures ANOVA or in the random coefficients analysis (Fig. 1).

#### A la carte offerings and sales

At the end of the intervention, the proportion of healthier foods available in intervention schools had more than doubled and offerings of less healthful choices had declined. Similar shifts were seen in the control condition offerings (Table 2). The results from the ANCOVA show that the differences between intervention and control schools in a la carte items offered was significant ( $P = 0.04$ ). The results

Table 2  
Proportion of foods to promote/foods to limit offered and sold on a la carte by time and condition—TEENS Study, Minneapolis, Minnesota, 1997–2000 ( $n = 13$  schools)

	Intervention		Control	
	Baseline (%)	Follow-up (%)	Baseline (%)	Follow-up (%)
<i>Foods offered*</i>				
Foods to limit	79	58	93	76
Foods to promote	21	42	7	24
<i>Foods sold**</i>				
Foods to limit	90	64	96	82
Foods to promote	10	36	4	18

\* Statistically significant difference in proportion by treatment status at follow-up ( $P = 0.04$ , one-tailed test).

\*\* Trend toward statistically significant difference in proportion by treatment status at follow-up ( $P = 0.07$ , one-tailed test).

from the ANCOVA for sales of a la carte items show a trend toward significant differences between treatment conditions ( $P = 0.07$ ).

## Discussion

The environmental-level results from TEENS were mixed. On the positive side, schools exposed to the TEENS environmental interventions offered a healthier mix of options on the a la carte line as compared to control schools. A trend toward a healthier proportion of “Foods to Promote” items sold on a la carte between intervention and control schools was also seen. This is an important finding suggesting that school food service can offer healthier foods items for a la carte, and if provided with enough healthful, affordable, and appealing choices, students will purchase them. At the home level, we were able to demonstrate positive intervention results for the shopping pairs scale, using a non-validated measure developed for TEENS. This change may reflect response bias rather than a change in purchasing behavior in parents exposed to the TEENS intervention.

No intervention effects were seen for the home shelf inventory. Process data indicate that 37% and 26% of families mailed in behavioral coupons in years 1 and 2 of the intervention, respectively. It has been difficult to design school-based interventions linked with family that have the ability to show change at the student or family level (Nader et al., 1989; Luepker et al., 1996; Baranowski et al., 1990). More work is needed in this area as it is recognized that families’ eating patterns impact the nutritional health of youth (Baranowski and Hearn, 1997).

TEENS was one of the first large-scale studies to attempt to intervene on the school food environment beyond the school meal pattern lunch. Only a few other studies have tested this environmental intervention approach with mixed results (French et al., 2004; Sallis et al., 2003; Zive et al., 2002). Intervention strategies to affect change in a la carte clearly need further attention. In developing the a la carte intervention for TEENS, we relied on formative assessment conducted with school food service staff to gain an understanding of the role of a la carte foods in middle school cafeteria. We learned a great deal as we moved through the intervention. For example, we learned that it was important to have both school food service workers and students taste test new products. If food service workers perceive that a lower fat product would not taste good and believe that it would not be well received by students, they will resist ordering the product. After realizing this resistance, we included taste testing of lower fat products in our food service trainings and began ordering products for schools to try, thereby reducing their financial risk for purchasing foods that might not move on the a la carte lines. We also learned that many school food service workers under-estimated the affect of pricing on student choice. Accordingly, we developed training and intervention strategies related to reducing the price of healthier choices.

TEENS also broke new ground on assessing change on a la carte. Unlike work done on assessing meal pattern lunch



(Ebzery et al., 1996; Burghardt et al., 1995), there were no published tools for assessing what was available or purchased from a la carte. There is a great need for valid and reliable tools to assess the larger school environment that are easy and inexpensive to implement (Lytle and Fulkerson, 2002).

Contamination may have impacted our ability to see intervention effects in the fruit and vegetable and a la carte sales results. Our study design involved randomizing schools, not school districts, to condition. Three of eight school districts had schools randomized to both treatment and control conditions. District level school food service directors were involved in the intervention as they needed to support the intervention efforts and sometimes approve food purchases. While we asked the district level directors to only make and support TEENS intervention strategies in their schools randomized to the treatment condition, our results suggest that this isolation did not happen. In addition, cooks and cook managers have the opportunity to interact at district and state food service meetings. There is little to stop the sharing of new products, information or students' responses to healthier options between workers. Future intervention work attempting to impact the larger school environment should randomize at the district, rather than school level.

## Conclusions

There is great need for research on how to impact the school and the home food environment. While financial conditions may mean that a la carte is here to stay, at the very least, we can make sure that the choices that students have at school include plenty of nutritious and appealing offerings, both in terms of taste and price. A great deal of work needs to be done with school food service staff and school administrators to convince them that a la carte offerings do affect the nutritional health of students, that students will buy healthful options and that income from a la carte does not need to be negatively impacted by offering more healthful choices. Training of food service around how to identify more healthful a la carte items, how to place and promote items on a la carte and work with vendors to increase the availability of healthier snack items is also needed.

Changing the home food environment is likely more difficult. Families' decisions about foods available in their home are shaped by myriad complex factors including taste preferences of family members, cultural preferences, and work and school schedules. Occasional messages about healthy food choices coming from school to home as part of a school health curriculum are not likely to be strong enough to change the family food environment.

Finally, much work is needed on developing and validating school-level measures assessing the food environment. If we are serious about considering eating behavior of youth from an ecological perspective and impacting environments as well as individual behaviors, we must develop and disseminate valid and reliable tools to assess environmental factors (Lytle and Fulkerson, 2002; Richter et al., 2000).

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