

# Improvements in Middle School Student Dietary Intake After Implementation of the Texas Public School Nutrition Policy

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Public health efforts to reduce the increasing rates of childhood obesity<sup>1</sup> have recently focused on school food environments.<sup>2</sup> Although regulations exist for National School Lunch Program (NSLP) meals, there are no federal rules for competitive foods sold elsewhere in the school such as in snack bars and vending machines, except for foods of minimal nutritional value (e.g., soda).<sup>3</sup> This has become an issue because the school environment influences dietary behavior.<sup>4</sup> For example, middle school students with access to snack bar and a la carte foods consumed more sweetened beverages and french fries, and fewer fruit and vegetables compared with elementary school students without snack bars.<sup>5,6</sup> The number of snack vending machines was negatively related to daily fruit consumption among middle school youth.<sup>7</sup> In high schools where soft drink machines were turned off during lunch, students purchased fewer soft drinks compared with students in schools where these machines were on during lunch.<sup>8</sup> Improving types and portion sizes of foods available in school snack bars and a la carte could reduce the source of kilojoules available for student purchase and possibly improve energy balance.<sup>9</sup>

States, school districts, and individual schools have enacted laws and policies regarding foods and beverages available in school food environments.<sup>10</sup> The beverage industry also developed a voluntary beverage vending policy for schools.<sup>11</sup> Such changes are controversial, and barriers to improving school food environments exist. These include the revenue generated from vending and snack bar and a la carte sales,<sup>12</sup> school staff, student and parent attitudes toward types of foods expected in schools,<sup>13</sup> and the concern that limiting access to these foods at school will not improve overall student dietary intake.<sup>14</sup> Critics suggest that if these items are not available in schools,

**Objectives.** We assessed the effect of the Texas Public School Nutrition Policy on middle school student lunchtime food consumption.

**Methods.** Three years of lunch food records were collected from middle school students in southeast Texas: baseline (2001–2002), after local district changes (2002–2003), and 1 year after implementation of the Texas Public School Nutrition Policy (2005–2006). Students recorded amount and source of foods and beverages they consumed. Analysis of variance and covariance and nonparametric tests were used to compare intake after the policy change with intake during the 2 previous years.

**Results.** After implementation of the nutrition policy, student lunch consumption of vegetables, milk, and several nutrients increased (protein, fiber, vitamins A and C, calcium, and sodium), and consumption of less desirable items (sweetened beverages, snack chips) decreased, as did percentage of energy from fat. Most of the desired nutrients and foods (vegetables and milk) were obtained from the National School Lunch Program meal. Fewer sweetened beverages, candy, chips, and dessert foods were purchased and consumed, but more of these items were brought from home and purchased from the snack bar.

**Conclusions.** Overall, state school nutrition policies can improve the healthfulness of foods consumed by students at lunch. (*Am J Public Health*. 2008;98:111–117. doi:10.2105/AJPH.2007.111765)

students will compensate by increasing consumption of desired foods in out-of-school environments.<sup>14</sup>

Few data exist for the effect of policy changes on actual food consumption by students at school. One recent study documented significant improvements in food consumption by Texas middle school students (more milk, calcium, and vitamin A; fewer sweetened beverages) after a local school district enacted a snack bar food policy change.<sup>15</sup> Consumption of chips purchased from the snack bar declined, but consumption of chips from vending machines increased, because the school administration, which was responsible for vending machines, made no changes. These results suggest that all school food sources have to make similar changes to favorably influence consumption.

The Texas Public School Nutrition Policy, an unfunded mandate to promote a healthy school environment for Texas students, was

implemented statewide in the fall of 2004. The guidelines apply to all school food sources, including vending machines.<sup>16</sup> For middle schools, the policy restricts the portion sizes of high-fat and sugar snacks (limits vary by food group), sweetened beverages ( $\leq 12$  oz), and the fat content of all foods served ( $\leq 28$  grams of fat per serving no more than 2 times per week). It also sets limits on the frequency of serving high-fat vegetables such as french fries (3 oz per serving no more than 3 times per week). We report the results of a naturalistic study that assessed the effect of the Texas Public School Nutrition Policy on lunch consumption of middle school students in southeast Texas. Student lunch consumption data for 2 previous years were available for comparison.<sup>15</sup>

## METHODS

Three middle schools in a school district in southeast Texas participated in this study.

During the 2001–2002 school year (year 1), the 3 schools had participated as control schools in a school-based intervention<sup>17</sup> during which the students anonymously completed lunch food records. Lunch consumption data were also collected from these 3 schools during the 2002–2003 school year (year 2), after the food service director implemented local policy changes and removed snack chips, candy, and many desserts from all district middle school snack bars and removed vending machines from the cafeterias. We were able to collect another year of lunch food records from these 3 schools during the 2005–2006 school year (year 3), the second year that the Texas Public School Nutrition Policy was in effect. All parents received study information and were notified that their child could assent or refuse to provide anonymous lunch consumption data.

Demographics of the 3 schools for years 1 and 2 were similar; some changes occurred for year 3. Enrollment increased from about 900 to 1100 students per school. The percentage of students eligible for free or reduced-price meals increased from 26% to 38%, 50% to 66%, and 68% to 75% in the 3 schools. The percentage of Hispanic students increased slightly (35% to 45%; 62% to 71%, 87% to 89%), whereas the percentage of White students decreased slightly (11% to 9%, 29% to 17%, 61% to 48%).

From September to May during all 3 years, anonymous lunch food records were completed by assenting students in the cafeteria immediately after eating lunch, which maximized the accuracy of self-report.<sup>18</sup> Reports were completed by students in the sixth through eighth grades. Trained data collectors were in the schools 3 to 5 days per week. They selected 1 to 2 tables of students at each lunch period and asked students to complete the anonymous food records for lunch only. No data were recorded on refusals. Students could have completed more than 1 lunch food record during each school year. The data collectors showed the students how to record the foods eaten at that meal: listing each food on a separate line, indicating how many servings were eaten, and identifying the source of each food (school lunch, snack bar, home, vending machine, other source). This method of data collection was shown to be

valid in previous research.<sup>19</sup> To enhance student interest, small incentives were provided. Pencils were distributed to participating students during years 1 and 3; in year 2, students who completed food records wrote their names on slips of paper, which were entered into a weekly raffle for a \$25 gift card.

Data from the food records were entered into Nutrition Data System (versions 4.2 and NDS-R–2005; Nutrient Coordinating Center, University of Minnesota, Minneapolis), to obtain average daily lunch consumption of nutrients and servings of fruit or fruit juice, vegetables, high-fat vegetables, milk, sweetened beverages, soft drinks (also included in total sweetened beverages), candy, dessert foods, and snack chips<sup>20</sup> for the total meal, and the percentage from each meal source. Daily averages of each nutrient and food group consumed during lunch, per student, were calculated by summing the consumption of each variable over the week and dividing by the number of food records for the week.

The percentage of total food consumption for each variable by source was also calculated by dividing the consumption by source by the total consumption for the day. A series of 1-factor (school year) analyses of variance and covariance were applied to total nutrient and food group consumption data and to each of the 4 food sources to investigate differences in total lunch consumption after the Texas nutrition policy change. Each of the 5 series (total consumption, percentage of kilojoules consumed from the NSLP meal, percentage from the snack bar, percentage from vending machines, and percentage from home) consisted of 10 nutrients and 9 food groups.

Post hoc investigations of variables exhibiting significant global effects were limited to comparing year 3 to years 1 and 2, respectively. To control for total energy intake at lunch, we repeated the analyses included total kilojoules consumption as a covariate. We used nonparametric Kruskal–Wallis analyses to investigate differences in the proportion of consumption from each meal source (NSLP, snack bar, vending machine, home) for each comparison. Because of the Texas food and beverage guidelines, the food source percentages for most food groups were severely skewed in year 3; therefore, nonparametric procedures were necessary. To maintain an

overall series-wise significance level of .05 or less and to control for inflated type I error caused by multiple testing, significance levels of .005 and .003 were applied to global tests and post hoc comparisons, respectively.

## RESULTS

There were 2671 self-reported food records for year 1, 5273 for year 2 and 10234 for year 3. In year 1, the data collectors were only in the schools about 50% of the time. The school district had an exclusive contract with a national beverage company, and individual principals determined the number of both beverage and snack food vending machines that would be in their school. In year 1, the 3 schools had 21 vending machines; 86% dispensed beverages. There were 42 machines during year 2, of which 83% dispensed beverages. After the Texas policy was implemented, there were only 23 machines (6, 7, and 10 per school), of which 61% dispensed beverages. The beverage contract in effect at that time specified 20-oz beverages, but machines were being changed to 12-oz beverages during the 2005–2006 school year to adhere to the Texas policy guidelines. The snack machine inventory adhered to the policy, but the machines were turned off during lunchtime. The NSLP meal was on a 5-week menu cycle. Only 1% milk was served, and approximately 5 different fruits and vegetables were offered each day, not counting potatoes.

Significant global effects were found for all nutrients except for iron and the percentage of kilojoules from saturated fat (Table 1). Post hoc procedures showed that consumption of kilojoules, protein, fiber, vitamin A, vitamin C, calcium, and sodium was higher in year 3 than year 1. The percentage of kilojoules consumed from fat was significantly lower, and vitamin C and protein consumption were significantly higher in year 3 than in year 2. The change in sodium consumption was no longer significant after we controlled for energy intake.

We observed significant differences in the percentage of consumption of all nutrients from the NSLP meal, snack bar, and vending machines (Table 1). Specifically, the percentages of nutrients consumed from the NSLP meal were significantly higher and the

**TABLE 1—Daily Lunch Nutrient Consumption per Student for School Years 2001–2002 (Year 1), 2002–2003 (Year 2), and 2005–2006 (Year 3) in 3 Schools in Texas**

| Nutrient  | Mean (SD)               | From NSLP, % | From Snack Bar, % | From Vending Machines, % | Brought From Home, % | Significant Pairwise Comparison for Food Source |                                   |
|---|-------------------------|--------------|-------------------|--------------------------|----------------------|---|-----------------------------------|
|   |                         |              |                   |                          |                      | Year 1 vs 3                                     | Year 2 vs 3                       |
| Energy, <sup>a,b</sup> kJ                       |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar, vending machines |
| Year 1  | 2646 (319) <sup>x</sup> | 53           | 24                | 12                       | 11                   |   |                                   |
| Year 2  | 2873 (349)              | 60           | 21                | 12                       | 8                    |   |                                   |
| Year 3  | 2990 (143) <sup>y</sup> | 83           | 11                | 1                        | 6                    |   |                                   |
| Protein, <sup>a,b</sup> g                       |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 22.2 (4.0) <sup>x</sup> | 63           | 27                | 1                        | 9                    |   |                                   |
| Year 2  | 23.9 (3.1) <sup>x</sup> | 71           | 20                | 3                        | 6                    |   |                                   |
| Year 3  | 28.2 (1.6) <sup>y</sup> | 93           | 3                 | 0                        | 4                    |   |                                   |
| % of kilojoules from fat <sup>a,b</sup>         |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 37.6 (2.7)              | 56           | 29                | 4                        | 11                   |   |                                   |
| Year 2  | 36.8 (2.3) <sup>x</sup> | 66           | 22                | 5                        | 8                    |   |                                   |
| Year 3  | 34.3 (1.5) <sup>y</sup> | 87           | 7                 | 0                        | 6                    |   |                                   |
| % of kilojoules from saturated fat <sup>b</sup> |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar, vending machines |
| Year 1  | 12.9 (1.8)              | 58           | 29                | 3                        | 11                   |   |                                   |
| Year 2  | 13.4 (1.2)              | 66           | 23                | 4                        | 7                    |   |                                   |
| Year 3  | 12.8 (1.0)              | 88           | 8                 | 0                        | 4                    |   |                                   |
| Fiber, <sup>a,b</sup> g                         |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 3.7 (0.8) <sup>x</sup>  | 62           | 23                | 4                        | 12                   |   |                                   |
| Year 2  | 4.3 (1.1)               | 69           | 15                | 8                        | 8                    |   |                                   |
| Year 3  | 5.1 (0.4) <sup>y</sup>  | 91           | 4                 | 0                        | 5                    |   |                                   |
| Vitamin A, <sup>a,b</sup> RE                    |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 151 (56) <sup>x</sup>   | 72           | 19                | 1                        | 8                    |   |                                   |
| Year 2  | 207 (40)                | 77           | 19                | 1                        | 4                    |   |                                   |
| Year 3  | 220 (14) <sup>y</sup>   | 94           | 5                 | 0                        | 2                    |   |                                   |
| Vitamin C, <sup>a,b</sup> mg                    |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 13.9 (5.0) <sup>x</sup> | 68           | 18                | 3                        | 10                   |   |                                   |
| Year 2  | 14.8 (3.2) <sup>x</sup> | 70           | 14                | 7                        | 9                    |   |                                   |
| Year 3  | 26.9 (3.4) <sup>y</sup> | 93           | 2                 | 1                        | 4                    |   |                                   |
| Iron, <sup>b</sup> mg                           |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 3.4 (0.7)               | 58           | 26                | 5                        | 12                   |   |                                   |
| Year 2  | 3.7 (0.4)               | 67           | 19                | 7                        | 7                    |   |                                   |
| Year 3  | 4.0 (0.2)               | 89           | 5                 | 0                        | 6                    |   |                                   |
| Calcium, <sup>a,b</sup> mg                      |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 292 (88) <sup>x</sup>   | 66           | 23                | 3                        | 8                    |   |                                   |
| Year 2  | 386 (79)                | 74           | 19                | 2                        | 4                    |   |                                   |
| Year 3  | 454 (35) <sup>y</sup>   | 94           | 4                 | 0                        | 2                    |   |                                   |
| Sodium, <sup>a,b,c</sup> mg                     |                         |              |                   |                          |                      | NSLP, snack bar, vending machines               | NSLP, snack bar                   |
| Year 1  | 1020 (167) <sup>x</sup> | 58           | 27                | 3                        | 12                   |   |                                   |
| Year 2  | 1169 (150)              | 66           | 22                | 5                        | 7                    |   |                                   |
| Year 3  | 1237 (92) <sup>y</sup>  | 91           | 3                 | 1                        | 5                    |   |                                   |

Note. NSLP= National School Lunch Program; RE= retinol equivalents. Percentage of nutrient consumed from each meal was aggregated weekly (n<sub>1</sub> = 24, n<sub>2</sub> = 28, n<sub>3</sub> = 21). X, Y significant (P < .025) pairwise comparison noted between years. No significant difference in percentage between any years observed for the “home” source.

<sup>a</sup>Significant global effect for year for consumption.

<sup>b</sup>Significant global effect for percentage for at least 1 meal source.

<sup>c</sup>Not significant (P > .005) after adjustment for total kilojoules.

percentages of nutrients consumed from the snack bar food were lower in year 3 compared with both previous years. The percentages of all nutrients consumed from vending machine items were significantly lower in year 3 compared with year 1. The percentages of nutrients consumed from vending machine items were significantly lower in year 3 compared with year 2 for kilojoules, percentage of kilojoules from saturated fat, iron, calcium, and sodium. There were no differences in the percentage of nutrients from home-supplied food.

We observed significant global effects for servings of vegetables, milk, sweetened beverages, soft drinks, and snack chips (Table 2). More milk and vegetables and less sweetened beverages, soft drinks, and snack chips were consumed in year 3 than during years 1 and 2. After we controlled for energy intake, dessert food servings were significantly lower in year 3 compared with year 1.

Significant differences were found in the consumption of all food and beverage sources except for fruit and fruit juice servings (Table 2). When we compared year 3 with year 1, we found that more servings of regular vegetables and milk were consumed from the NSLP meal and fewer dessert foods, soft drinks, and snack chips were consumed from the NSLP meal. The snack bar provided more sweetened beverages, candy, and dessert foods, and fewer regular and high-fat vegetables, milk, and snack chips, and vending machines provided fewer sweetened beverages and soft drinks, candy, dessert foods, and snack chips in year 3 than in year 1. However, more sweetened beverages, soft drinks, dessert foods, candy and snack chips were brought from home.

When we compared year 3 with year 2, we found that there were fewer differences, which indicated that local policies made a difference. Food reports indicated that significantly fewer soft drinks were obtained from the NSLP meal (Table 2). The snack bar provided significantly more sweetened beverages, candy, and dessert foods but almost no snack chips. However, overall consumption of these foods declined between the 2 years. Significantly fewer sweetened beverages and soft drinks, candy, dessert foods, and chips were obtained from vending machines in year 3 than in year 2. However, significantly more sweetened beverages and

soft drinks, dessert foods, and chips were brought from home.

Table 3 provides the number of NSLP meals served for the 3 study years. During year 3, the food service director reduced the snack bar to only a few items, and students were encouraged to take a reimbursable meal. The total number of enrolled students increased about 200 per school (−20%) from year 1 to year 3. The number of students certified as eligible for free or reduced-price meals increased 45% (from 2690 to 3306) between years 1 and 3. However, the number of free and reduced-price meals served increased by much greater percentages during this period—77% and 127%, respectively—than would be expected by the 45% increase in those eligible. The number of full-pay lunch meals increased by 143% during this period. These results document that the strategy of reducing snack bar offerings does increase the number of students consuming reimbursable meals.

## DISCUSSION

### Overall Lunch Consumption Changes

Our goal was to identify the effect of a statewide school nutrition policy on student dietary behaviors by using lunch food records collected for 3 years: 2001–2002 (year 1), 2002–2003 (year 2), and 2005–2006 (year 3).

Compared with year 1, year 3 data showed that the Texas Public School Nutrition Policy significantly increased student consumption of kilojoules, protein, fiber, calcium, vitamins A and C, and servings of vegetables and milk. By contrast, students consumed fewer sweetened beverages (including soft drinks), dessert foods, and chips in year 3. Fewer improvements were noted when years 2 and 3 were compared, although students reported consuming more protein and vitamin C, and a lower percentage of energy from fat in year 3.

These significant improvements remained even after we controlled for total energy intake at lunch, which suggests that the improvements were related to the quality of the food and beverage choices. In fact, meal source analyses showed significant increases: more than 85% of the healthful food selections were from the NSLP meal. These results

suggest that reduced access to less healthful food and beverage selections does shift middle school student meal choices to the more healthful alternatives available in the NSLP meal. For example, from year 1 to year 3, total fruit and vegetable consumption (not including french fries) increased from .61 to 1.34 servings, milk intake increased from 2.4 to 6.5 oz, whereas sweetened beverage intake declined from 5.4 to 1.5 oz, and snack chip intake decreased from 0.21 to 0.04 servings.

These improvements were obtained without a behavior change intervention. In fact, previous fruit and vegetable behavior change interventions among middle and high school students have not been successful.<sup>21,22</sup> It may be that the improved school food environment, free of low-nutrient and energy-dense items, is needed to overcome preferences and peer norms. The NSLP components include 8 oz of milk and 2 servings of fruit or vegetable, or both, per meal. In a previous study, fruit and vegetable social norms were positively correlated to low-fat vegetable and fruit consumption among middle school students.<sup>23</sup> Therefore, students might have made more-healthful food choices when fewer high-fat sugary and salty foods were available, and these actions influenced their peers to also make healthier choices. However, there is room for an increase in total fruit and vegetable consumption to 2 servings per meal. This is an area of research deserving more attention.

The overall increase in consumption of kilojoules during lunch between years 1 and 3, from 2646 to 2990 kJ (630 to 712 kcal) reflects increased consumption of the NSLP meal and higher-quality foods and beverages. This increase might appear to be a negative effect, in light of the concern about obesity. However, US Department of Agriculture (USDA) regulations state that NSLP meals must provide one third of children's energy requirement, about 3465 kJ (825 kcal) for grades 7 to 12, and in year 3, actual student consumption was 2990 kJ (712 kcal). No data are available on the level of energy in lunch meals that promotes excess energy intake. The 2005 US Dietary Guideline recommendations link energy intake recommendations to expenditures.<sup>24</sup> Future research should investigate the energy needs of youth today.

**TABLE 2—Yearly Daily Lunch Servings per Student for School Years 2001–2002 (Year 1), 2002–2003 (Year 2), and 2005–2006 (Year 3) in 3 Schools in Texas**

| Servings                           | Mean (SD)                | From NSLP, % | From Snack Bar, % | From Vending Machines, % | Brought From Home, % | Significant Pairwise Comparison for Food Source |                                   |
|------------------------------------|--------------------------|--------------|-------------------|--------------------------|----------------------|---|-----------------------------------|
|                                    |                          |              |                   |                          |                      | Year 1 vs 3                                     | Year 2 vs 3                       |
| Fruit or juice                     |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 0.32 (0.25)              | 87           | 6                 | 0                        | 6                    |   |                                   |
| Year 2                             | 0.36 (0.30)              | 85           | 6                 | 1                        | 8                    |   |                                   |
| Year 3                             | 0.45 (0.06)              | 94           | 2                 | 0                        | 5                    |   |                                   |
| Vegetables <sup>a,b</sup>          |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 0.29 (0.12) <sup>x</sup> | 83           | 16                | 0                        | 1                    | NSLP, snack bar                                 | Home                              |
| Year 2                             | 0.20 (0.08) <sup>x</sup> | 94           | 4                 | 0                        | 2                    |   |                                   |
| Year 3                             | 0.89 (0.22) <sup>y</sup> | 99           | 1                 | 0                        | 1                    |   |                                   |
| High-fat vegetables <sup>b</sup>   |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 0.05 (0.10)              | 76           | 24                | 0                        | 0                    | Snack bar                                       |                                   |
| Year 2                             | 0.15 (0.19)              | 89           | 9                 | 0                        | 2                    |   |                                   |
| Year 3                             | 0.10 (0.09)              | 84           | 1                 | 0                        | 6                    |   |                                   |
| Milk, <sup>a,b</sup> oz            |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 2.44 (1.41) <sup>x</sup> | 88           | 9                 | 0                        | 3                    | NSLP, snack bar                                 |                                   |
| Year 2                             | 4.40 (1.92) <sup>x</sup> | 92           | 6                 | 0                        | 2                    |   |                                   |
| Year 3                             | 6.54 (0.26) <sup>y</sup> | 99           | 1                 | 0                        | 0                    |   |                                   |
| Sweet beverages, <sup>a,b</sup> oz |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 5.43 (3.13) <sup>y</sup> | 9            | 13                | 72                       | 6                    | Snack bar, vending machines                     | Snack bar, vending machines, home |
| Year 2                             | 3.54 (1.68)              | 4            | 6                 | 78                       | 12                   |   |                                   |
| Year 3                             | 1.49 (0.20) <sup>x</sup> | 2            | 61                | 19                       | 18                   |   |                                   |
| Soft drinks, <sup>a,b</sup> oz     |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 4.76 (3.05) <sup>y</sup> | 5            | 8                 | 80                       | 4                    | NSLP, vending machines, home                    | NSLP, vending machines, home      |
| Year 2                             | 2.65 (1.26) <sup>y</sup> | 3            | 2                 | 86                       | 9                    |   |                                   |
| Year 3                             | 0.11 (0.11) <sup>x</sup> | 0            | 9                 | 11                       | 66                   |   |                                   |
| Candy <sup>b</sup>                 |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 0.09 (0.06)              | 20           | 24                | 39                       | 16                   | Snack bar, vending machines                     | Snack bar, vending machines, home |
| Year 2                             | 0.06 (0.05)              | 13           | 3                 | 56                       | 27                   |   |                                   |
| Year 3                             | 0.04 (0.01)              | 3            | 52                | 5                        | 40                   |   |                                   |
| Dessert foods <sup>b,c</sup>       |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 0.11 (0.10) <sup>y</sup> | 24           | 7                 | 22                       | 47                   | NSLP, snack bar, vending machines, home         | Snack bar, vending machines       |
| Year 2                             | 0.09 (0.09)              | 40           | 9                 | 13                       | 38                   |   |                                   |
| Year 3                             | 0.04 (0.02) <sup>x</sup> | 15           | 20                | 0                        | 64                   |   |                                   |
| Snack chips <sup>a,b</sup>         |                          |              |                   |                          |                      |   |                                   |
| Year 1                             | 0.21 (0.13) <sup>y</sup> | 10           | 41                | 31                       | 18                   | NSLP, snack bar, vending machines, home         | Snack bar, vending machines, home |
| Year 2                             | 0.20(0.11) <sup>y</sup>  | 12           | 20                | 47                       | 21                   |   |                                   |
| Year 3                             | 0.04 (0.02) <sup>x</sup> | 4            | 1                 | 6                        | 90                   |   |                                   |

Note. NSLP= National School Lunch Program. Percentage of nutrient consumed from each meal was aggregated weekly (n<sub>1</sub> = 24, n<sub>2</sub> = 28, n<sub>3</sub> = 21). Significant (P < .025) pairwise comparison notation among mean servings: mean (y) > mean (x).

<sup>a</sup>Significant global effect for year for consumption.

<sup>b</sup>Significant global effect for percentage for at least 1 meal source.

<sup>c</sup>Significant (P > .005) after adjustment for total kilojoules.

The reduction in the percentage of kilojoules consumed from fat between years 1 and 2 to year 3 (34.3%) is important because the USDA regulations in place for these 3 years called for an average of 30% of kilojoules from fat

over a week. However, the 2005 US Dietary Guidelines have relaxed this recommendation to between 20% and 35% of calories,<sup>24</sup> which may lead to the amendment of NSLP guidelines. The percentage of kilojoules consumed

from fat did not change (12.8%) from years 1 and 2 to year 3, and was above the 10% guideline for NSLP meals and the US Dietary Guidelines. Future research should investigate methods to reduce saturated fat in NSLP meals.

**TABLE 3—Number School Lunches Served and Sold per School in 3 Schools in Texas**

| National School Lunch Program Annual Sales for all 3 Schools                             | Year 2001–2002, No. | Year 2002–2003, No. (% change) | Year 2005–2006, No. (% change) |
|--|---------------------|--------------------------------|--------------------------------|
| Type of lunch  |                     |                                |                                |
| Free   | 135 033             | 155 346 (+ 15%)                | 239 046 (+ 77%)                |
| Reduced price  | 25 137              | 31 596 (+ 25%)                 | 57 301 (+ 127%)                |
| Full price   | 45 377              | 33 275 (-27%)                  | 110 716 (+ 143%)               |
| Historical data <sup>a</sup>   |                     |                                |                                |
| No. of students at all 3 schools <sup>a</sup>  | 2 690               | 3 074                          | 3 306                          |
| % of students receiving free or reduced-price lunch averaged over 3 schools <sup>a</sup> | 47                  | 54                             | 68                             |

*Note.* Data provided by school food service. Values in parentheses represent increases (+) or decreases (-) from 2001 to 2002 values.

### Snack Bar and Vending Changes

The Texas policy had mixed results in the snack bar. For most nutrients, consumption declined from year 1 to year 3, which reflected the reduced access to many food and beverage items and the selection of the NSLP meal. Consumption of both regular and high-fat vegetables and milk from the snack bar also declined. The increased consumption of sweetened beverages (13% to 61%) and dessert foods (7% to 20%) from the snack bar probably reflects the sales of foods allowed under the new policy (12-oz containers of ice tea, lemonade, and fruit drinks; small packages of cookies, muffins, and ice cream), as well as less access to beverage and snack vending machines. However, overall consumption of sweetened beverages and dessert foods declined significantly (from 5.4 to 1.5 oz of sweetened beverages, and from 0.11 to 0.04 servings of dessert foods).

Although 52% of candy consumption in year 3 was reported to be from the snack bar (0.02 serving), candy was not available in the snack bar that year. This probably reflects student recording error. The other major source of candy was from home (40%). The 3% of candy reported to be from the NSLP meal probably also represents student recording error because candy was not available in NSLP meals. No chips were sold in the snack bar, and in year 3, consumption of chips was reduced by 81%, from 0.21 to 0.04 servings per day. To some extent, the reduced number of food and beverage items

offered in the snack bar accounts for the differences between year 2 and year 3.

Changes in student consumption of vending machine items were most notable for amount of kilojoules consumed, the percentage of kilojoules consumed from fat and saturated fat, sweetened beverages, soft drinks, candy, dessert foods and snack chips. The proportion of these items supplied by vending machine foods were significantly reduced from year 1 to year 3. The Texas nutrition policy in year 3 covered all school food environments in contrast to the local school food policy implemented in year 2, which did not include vending changes.<sup>15</sup> The vending machine issue is notable when examining year 1 and 2 consumption of sweetened beverages, soft drinks, candy, dessert foods, and snack chips from vending machines.<sup>15</sup> Students appeared to shift to using the school vending machines in year 2, and although overall student lunch consumption improved for milk and sweetened beverages, consumption of snack chips from vending machines increased.<sup>15</sup> In our study, the Texas nutrition policy in year 3 did significantly reduce overall snack chip, soda, sweetened beverage, and dessert food consumption, and reduced the percentages of these items plus candy that were consumed from vending machines. In year 3, there were 4 to 6 beverage vending machines per school, soda was not available, and the snack machines were turned off at lunch. Our results indicate that reducing access to vending machines does favorably affect student dietary behaviors.<sup>9</sup>

### Changes in Food From Home

Most snack chips (90%), 66% of soft drinks, 64% of dessert foods, and 40% of candy consumed were brought from home in year 3. However, overall consumption of all items except candy was reduced in year 3 compared with years 1 and 2, which suggests that little compensation occurred from items brought from home. Whether more students brought these foods from home in response to reduced school access is unknown. This is an important area for further research.

### National School Lunch Meals

One important outcome is the increase in free (77%), reduced-price (127%), and full-price (143%) NSLP meals served in year 3 compared with year 1. Each school recorded an increase of about 200 students during this period and an increase in the number of children eligible for free or reduced-price meals. However, the increase in eligible students was only 45%. These increases were obtained by the limited snack bar offerings and by encouraging students in the snack bar line to select a reimbursable meal. Both the food service department and students were positively affected. The school food service department received greater monetary reimbursement for these meals, and the students reported higher-quality nutrient intake.

There are several limitations that should be noted. All of the student data were from self-report, which is limited by memory and ability to estimate portion size.<sup>25</sup> No demographic information associated with the individual food records was collected during the first 2 years, and no comparison between those who did and did not complete food records can be calculated. We were unable to ascertain which students provided multiple assessments, although we attempted to minimize this bias by aggregating the data at the weekly level. On average, 47%, 54%, and 68% of all the students were certified for free or reduced-price meals across the 3 years, respectively. Therefore, generalizability is limited. We were also unable to account for bias associated with social clustering at lunch tables and did not take into account the possible clustering effect of school, because of the small number of schools in the study.

Finally, dietary changes that occur in school may not reflect dietary changes over a 24-hour period. One criticism of school food regulations is that students will compensate and increase consumption of restricted foods outside of school.<sup>14</sup> This is an important area for further research. Capturing 24-hour dietary intake would have helped to answer this concern. Future research on changes in school food environments should include 24-hour food recalls. The food service department and participating schools in this district were very compliant with the state policy. Results might vary across schools that are less compliant.

Food records documented that a statewide nutrition policy that affects all school food environments improved student lunch dietary intake. These results can be used to promote state and local school wellness and nutrition policies. ■

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### Contributors

K. Cullen originated the study, oversaw implementation, and wrote the article. K. Watson and I. Zakeri conducted the data analyses and participated in manuscript preparation.

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### Human Participant Protection

The study was approved by the Baylor College of Medicine institutional review board.

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