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# Nutrient Contributions of the Five Meal Components in School Lunch: Entrée, Milk, Vegetable/Fruit, Bread/Grain, and Miscellaneous

Seunghee Wie,[1]† Carol W. Shanklin[2]

*Department of Family and Consumer Sciences,[1] California State University, Sacramento, California, USA*
*Department of Hotel, Restaurant, Institution Management, and Dietetics,[2] Kansas State University, Manhattan, Kansas, USA*

## ABSTRACT

This retrospective study was designed to evaluate the nutrient contributions of the five meal components of school lunch menus planned for elementary students in two school districts (District A and B) in the Midwestern state of the United States. The 4-week cycle menu was planned for two time periods (Period 1 and Period 2) following guidelines for NuMenus and general menu planning principles. Menu components of planned and served menus for two time periods were analyzed using Nutri-Kids™. No significant differences in the nutrient content of between Periods 1 and 2 were found for District A. District B served significantly more vitamin A and total fat in Period 1 and significantly more calories, iron, vitamin A, protein, and total fat in Period 2 than was planned. The major nutrients provided by the entrée component included protein, calories, cholesterol, total fat, saturated fat, and sodium. Milk was an important source of calcium and provided approximately one-third of the total protein and vitamin A in the meal. The vegetable/fruit component was the major source of vitamins A and C. The grain/bread component provided approximately 20% of the carbohydrates among five meal components. The miscellaneous component affected the sodium and fat content of the menus. Menu planners can use the results of this study to enhance their knowledge of the nutrient contributions of each meal component and as inputs for planning menus that meet children's nutritional requirements. (*J Community Nutrition* 8(1): 3~8, 2006)

KEY WORDS: planned menu · served menu · five meal components.

## Introduction

The School Nutrition Dietary Assessment (SNDA) study found that the amounts of most nutrients provided in the school lunch exceeded the National School Lunch Program's (NSLP) requirement of one-third of the Recommended Dietary Allowances (RDAs) for all age groups at each school level. However, the *Dietary Guidelines for Americans* of 30% calories from total fat and 10% calories from saturated fat were exceeded in the majority of the lunches analyzed in the SNDA study (Burghardt et al. 1995). Results of the SNDA study initiated one of the most comprehensive changes in the NSLP since its inception.

In 1995, the U.S. Department of Agriculture (USDA) finalized the School Meal Initiative (SMI) for Healthy Children (USDA 1995). Changes to the NSLP and School Breakfast Program (SBP) included revising nutrition requirements, identifying several menu planning options, and streamlining program administration. Nutrition standards required compliance with the *Dietary Guidelines* applicable to school-age children including limiting the amounts of total fat and saturated fat in the meals. The regulations specified that meals provide 1/4 of the RDAs and 1/3 of the RDAs for protein, vitamin A, vitamin C, iron, calcium, and calories at breakfast and lunch, respectively. The nutrient analysis to evaluate whether meals meet these requirements is based on average nutrient content of the meals for a school week. Two menu planning alternatives were added to the regulations: the Nutrient Standard Menu Planning (NSMP) is also referred to as NuMenus and Assisted NuMenus (ANSMP) (USDA 1995). Both provided

†**Corresponding author** : Seunghee Wie, Department of Family and Consumer Sciences, California State University, Sacramento, California 95819-6053, USA
Tel : (916) 278-7520, Fax : (916) 278-7520
E-mail : wie@csus.edu

more flexibility by eliminating designated components and quantity requirements for the components (School Nutrition Association 2000).

The USDA then approved the enhanced food-based menu planning option, which increased the number of servings of grains/breads and fruits/vegetables to provide sources of low-fat calories. In May 2000, the final rule regarding the additional menu planning approaches was adopted. Schools are now allowed to use any reasonable approach to plan menus. It gave school food authorities the option of choosing the menu planning alternative that best meets the needs of the district (USDA 2000).

Several studies have been conducted to determine compliance with the USDA meal patterns and the 1990 *Dietary Guidelines* (Burghardt et al. 1995; Farris et al. 1996; Hoover et al. 1998; Nicklas 1995). Results of these studies indicated that NSLP lunches met the requirement of 1/3 RDA but did not follow the *Dietary Guidelines* for sodium, fiber, or the percentages of calories from fat and saturated fat. These studies described the percentage contributions or actual amounts of different nutrients available in NSLP lunches based on the RDAs.

Other studies have evaluated the nutrient contribution of one meal component or one nutrient component in NSLP lunches (Hewes et al. 1996; Johnson et al. 1998). Hewes et al. (1996) examined changes in the total fat and saturated fat contents of meal components in school lunch and the specific strategies for fat modification in 96 public elementary schools (56 intervention; 40 control). The 56 intervention schools planned and prepared meals using the Eat Smart criteria for fat. Meals at those schools provided a significantly lower average percentage of calories from fat during five days of the study. The entrée component had the greatest reduction in fat ($p < 0.0001$ total fat; $p < 0.002$ saturated fat), followed by vegetables, milk, and desserts. The weekly average reduction in calories from total fat was related directly to the number of days that the schools met the criterion for each meal component. Johnson et al. (1998) compared the quality of the noon meal and the type of beverage consumed for children ages 5 to 17. The percentage of students selecting each type of beverage was 28% whole milk, 23% soft drinks, 21% low fat milk, 14% fruit drinks, 7% juice, 5% tea, and 2% skim milk. Only children who drank milk at the noon meal met or exceeded 1/3 of the RDA for calcium at lunch and 100% of the RDA for calcium daily based on their total diet. Children who drank whole milk consumed the highest number of calories and the greatest amounts of total fat, saturated fat, cholesterol, and sodium. In contrast, children who drank skim milk consumed the least amounts of these nutrients.

A review of literature did not find any previous research that had determined the nutrient contributions of each meal component in NSLP or compared the actual nutrient contributions of the served menu with those of the planned menu using NSMP. The purposes of this study were 1) to assess the nutrient contributions of the five meal components in school lunch menus planned using NSLP guidelines and 2) to compare nutrient contents of the planned and served menus.

## Methodology

### 1. Nutrient analysis of menus

This retrospective study was designed to evaluate the nutrient contributions of the five meal components of school lunch menus planned using NuMenus for the NSLP for elementary students in two school districts (District A and B) in the Midwestern state of the United States. The 4-week cycle menu was planned for two time periods (Period 1 and Period 2) following guidelines for NuMenus and general menu planning principles (USDA 1995).

The menus were designed to be the same for both periods and districts; however, changes were made based on input from the foodservice directors to accommodate student preferences, food production constraints, budgetary considerations, and religious holidays during Period 1. Nutri-Kids™ for windows® Software (Version 1.8.3, 04/4/2000, LunchByte Systems, Inc., Rochester, NY) was used to analyze the nutritional contents of the 4-week cycle menus as planned and served for Periods 1 and 2 based on weighting of the number of servings forecasted (Yakawich 1999).

The approved menus, based on the original forecast provided by the two foodservice directors and used for nutrient weighting, met the SMI guidelines and they were supposed to serve as they were planned. However, there might be differences between the planned and the served menus. For example, planned fresh vegetables might be replaced with the canned product during preparation, due to a market price, unavailability, etc. In District A, a peanut butter and jelly sandwich was offered as an alternative entrée choice at least once a week. For the nutrient analysis, this alternative menu was designed as Menu 2.

The nutritional contributions of the following meal components were analyzed for the menus as planned and served: entrée, milk, vegetable/fruits, grain/bread, and miscellaneous. The miscellaneous category included condiments, such as salad dressings, mustard, catsup, salsa, margarine, and other items accompanying the meal that were not included in another category. The percentage contributions to the total meal were determined for calories, protein, total fat, saturated fat, calcium, vitamin A, vitamin C, iron, sodium, and cholesterol. The nutritional contribution for each day and the average per week were determined and averaged out for both periods.

All menu items served using NuMenus guidelines require recipes. The nutritional contribution of the milk component was determined using recipes for milk in the Nutrikids™ database for each district. The recipes were based on the percentage of the different types of milk served prior to the study. District A's recipe per 100 servings was 70 − 1/2 pints of low fat chocolate milk, 24 − 1/2 pints of low fat milk, 4 − 1/2 pints of whole milk, and 2 − 1/2 pints of reduced fat milk. The milk recipe for District B per 100 servings was 67 − 1/2 pints of low fat chocolate milk, 28 − 1/2 pints of reduced fat milk, 4 − 1/2 pints of whole milk, and 1 − 1/2 pints of skim milk.

### 2. Data analysis

Descriptive statistics were computed to determine the percentage contribution for each menu component for each nutrient analyzed. One sample T-tests were used to determine significant differences in the nutrient contents between Periods 1 and 2 and between the planned and served menus.

## Results and Discussion

Table 1 shows the nutrient contributions of the five meal components for menus in School District A. Average percentage contributions for the two periods are presented, because

**Table 1.** Percentage nutrient contributions[a] of the five meal components for menus planned and served in School District A

| Nutrient | Menu | Entrée | | Milk[b] | | Vegetable/fruit | | Grain/bread | | Miscellaneous[c] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Menu 1 | Menu 2[d] | Menu 1 | Menu 2 | Menu 1 | Menu 2 | Menu 1 | Menu 2 | Menu 1 | Menu 2 |
| Calories | Planned | 37.0 | 37.7 | 19.1 | 19.1 | 14.6 | 14.5 | 17.9 | 17.9 | 11.4 | 10.8 |
| | Served | 36.0 | 35.0 | 19.3 | 19.9 | 14.7 | 15.0 | 16.6 | 17.0 | 13.5 | 13.1 |
| Calcium | Planned | 25.7 | 26.0 | 60.4 | 60.6 | 5.5 | 5.4 | 5.2 | 5.3 | 3.1 | 2.8 |
| | Served | 24.7 | 23.0 | 60.6 | 62.5 | 5.6 | 5.6 | 5.3 | 5.4 | 3.8 | 3.5 |
| Cholesterol | Planned | 68.4 | 63.5 | 19.4 | 22.7 | 2.8 | 3.3 | 5.5 | 6.4 | 3.9 | 4.1 |
| | Served | 66.2 | 57.4 | 20.9 | 26.7 | 3.2 | 4.1 | 3.8 | 4.9 | 5.9 | 6.9 |
| Sodium | Planned | 43.4 | 40.2 | 13.5 | 14.5 | 11.4 | 12.8 | 12.1 | 12.5 | 19.7 | 20.0 |
| | Served | 41.7 | 37.4 | 13.3 | 15.2 | 11.1 | 12.6 | 11.3 | 12.2 | 22.6 | 22.5 |
| Iron[e] | Planned | 25.5 | 26.0 | 0.4 | 0.4 | 15.3 | 15.0 | 16.2 | 16.2 | 42.6 | 42.3 |
| | Served | 20.3 | 19.0 | 0.4 | 0.4 | 12.5 | 12.4 | 18.6 | 18.8 | 48.3 | 49.4 |
| Vitamin A | Planned | 18.9 | 17.5 | 31.3 | 32.1 | 33.9 | 34.2 | 4.9 | 5.0 | 11.0 | 11.1 |
| | Served | 18.3 | 16.7 | 30.4 | 31.5 | 34.7 | 34.9 | 4.1 | 4.1 | 12.6 | 12.8 |
| Vitamin C | Planned | 13.2 | 13.5 | 5.3 | 5.4 | 77.9 | 77.4 | 0.6 | 0.6 | 3.0 | 3.2 |
| | Served | 12.5 | 17.1 | 5.3 | 5.2 | 75.6 | 71.4 | 0.6 | 0.6 | 5.9 | 5.7 |
| Protein | Planned | 51.5 | 50.4 | 28.8 | 29.7 | 7.8 | 7.9 | 9.8 | 10.1 | 2.1 | 1.9 |
| | Served | 50.5 | 46.6 | 29.5 | 32.1 | 8.0 | 8.6 | 9.2 | 10.0 | 2.8 | 2.6 |
| Carbohydrate | Planned | 24.8 | 26.0 | 23.3 | 23.1 | 22.5 | 22.2 | 21.8 | 21.6 | 7.5 | 7.1 |
| | Served | 24.2 | 24.7 | 23.6 | 23.7 | 22.7 | 22.6 | 20.0 | 20.0 | 9.5 | 9.1 |
| Total fat | Planned | 48.5 | 51.5 | 7.2 | 6.9 | 7.4 | 7.1 | 14.5 | 14.1 | 22.4 | 20.4 |
| | Served | 46.6 | 46.4 | 7.2 | 7.5 | 7.4 | 7.6 | 13.7 | 14.1 | 25.1 | 24.4 |
| Saturated fat | Planned | 46.9 | 48.6 | 18.1 | 17.7 | 4.6 | 4.5 | 14.2 | 13.9 | 16.2 | 15.3 |
| | Served | 47.2 | 43.9 | 18.3 | 19.8 | 5.3 | 5.6 | 11.8 | 12.7 | 17.4 | 17.9 |

[a] Percentage may not total 100 due to rounding.
[b] Type of milk served: 70% low fat chocolate, 24% low fat milk, 4% whole milk, and 2% reduced fat milk.
[c] Miscellaneous category includes condiments, such as salad dressing, mustard, catsup, and salsa.
[d] District A served two entree on selected days. The second entree was peanut butter and jelly sandwich and was served at least. Once per week as a choice. Menu 2 shows the contributions when a peanut butter and jelly sandwich was served as the entrée.
[e] The nutrient data for iron in one of the condiments was inaccurate for period 2 for district A. It could not be changed because the data were obtained from a USDA database.

**Table 2.** Percentage nutrient contributions[a] of the five meal components for menus planned and served during periods 1 and 2 in School District B

| Nutrient | Menu | Entrée | | Milk[b] | | Vegetable/fruit | | Grain/bread | | Miscellaneous[c] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Period 1 | Period 2 | Period 1 | Period 2 | Period 1 | Period 2 | Period 1 | Period 2 | Period 1 | Period 2 |
| Calories | Planned | 40.7 | 39.9 | 21.1 | 20.5 | 15.1 | 16.6 | 20.9 | 19.6 | 2.3 | 3.4 |
| | Served | 39.1 | 37.8 | 20.1 | 19.4 | 14.1 | 14.9 | 19.8 | 19.7 | 6.9 | 8.3 |
| Calcium | Planned | 23.1 | 24.2 | 66.9 | 65.1 | 4.8 | 5.5 | 3.0 | 2.9 | 2.3 | 2.2 |
| | Served | 22.4 | 22.7 | 63.2 | 62.1 | 4.7 | 4.8 | 3.3 | 3.3 | 6.4 | 7.1 |
| Cholesterol | Planned | 68.5 | 69.3 | 25.0 | 24.4 | 1.5 | 1.5 | 2.4 | 2.3 | 2.5 | 2.4 |
| | Served | 66.1 | 65.5 | 23.6 | 23.3 | 1.8 | 1.7 | 1.4 | 1.4 | 7.1 | 8.3 |
| Sodium | Planned | 50.1 | 49.5 | 15.0 | 14.5 | 10.5 | 10.3 | 17.7 | 16.7 | 6.8 | 9.0 |
| | Served | 47.1 | 45.5 | 14.2 | 13.8 | 10.7 | 9.7 | 16.6 | 16.8 | 11.4 | 14.2 |
| Iron | Planned | 53.6 | 52.7 | 0.9 | 0.9 | 15.1 | 16.4 | 29.1 | 27.6 | 1.3 | 2.5 |
| | Served | 52.1 | 51.7 | 0.9 | 0.9 | 16.2 | 15.6 | 28.2 | 27.5 | 2.6 | 4.3 |
| Vitamin A | Planned | 13.4 | 14.2 | 32.0 | 31.4 | 41.8 | 41.3 | 9.3 | 9.1 | 3.6 | 4.0 |
| | Served | 12.9 | 14.9 | 30.1 | 29.2 | 41.6 | 39.5 | 8.7 | 8.9 | 6.6 | 7.5 |
| Vitamin C | Planned | 13.8 | 13.5 | 7.1 | 6.9 | 77.0 | 77.5 | 0.4 | 0.4 | 1.7 | 1.7 |
| | Served | 14.9 | 16.1 | 7.6 | 7.9 | 73.0 | 72.5 | 0.5 | 0.5 | 4.1 | 2.9 |
| Protein | Planned | 53.8 | 54.1 | 28.5 | 28.3 | 6.8 | 6.8 | 9.6 | 9.4 | 1.2 | 1.4 |
| | Served | 52.7 | 52.6 | 27.8 | 27.5 | 6.7 | 6.6 | 9.2 | 9.5 | 3.5 | 3.8 |
| Carbohydrate | Planned | 26.1 | 24.8 | 23.9 | 23.1 | 23.1 | 25.6 | 25.6 | 23.9 | 1.3 | 2.6 |
| | Served | 26.0 | 25.1 | 23.9 | 23.1 | 22.5 | 24.0 | 25.3 | 24.8 | 2.4 | 3.0 |
| Total fat | Planned | 59.3 | 58.9 | 10.8 | 10.5 | 7.3 | 7.9 | 17.9 | 16.6 | 4.7 | 6.1 |
| | Served | 52.0 | 49.7 | 9.4 | 8.9 | 6.1 | 6.6 | 15.8 | 14.9 | 16.7 | 20.0 |
| Saturated fat | Planned | 46.9 | 48.7 | 27.9 | 26.5 | 1.4 | 1.6 | 16.9 | 15.9 | 6.9 | 7.3 |
| | Served | 43.4 | 43.1 | 24.4 | 24.4 | 1.1 | 1.3 | 14.0 | 14.1 | 17.0 | 17.0 |

[a] Percentage may not total 100 due to rounding.
[b] Type of milk served: 67% low fat chocolate, 28% reduced low fat milk, 4% whole milk, and 1% skim milk.
[c] Miscellaneous category includes condiments, such as salad dressing, mustard, catsup, and salsa.

no significant differences ($p \leq 0.05$) were found between Periods 1 and 2. Also, no significant differences were found between planned and served menus in the total amounts of each nutrient ($p \leq 0.05$).

The entrée component contributed 68% of the cholesterol, 52% of the protein, 49% of the total fat, 47% of the saturated fat, 43% of the sodium, and 37% of the calories for Menu 1 planned using NuMenus guidelines. The entrée contributions for Menu 1 as served were 66%, 51%, 47%, 47%, 42%, and 36% of the cholesterol, protein, total fat, saturated fat, sodium, and calories, respectively. When the peanut butter and jelly sandwich was served as the entrée (Menu 2), the percentage contributions were very similar except for cholesterol and sodium. But the difference was not significant.

Milk contributed approximately 61% of the calcium, 31% of the vitamin A, 30% of the protein, and 19% of the calories for both Menus 1 and 2 as planned and served. Less than 10% of total fat in the planned and served menus was from the milk component. The amount of calcium provided by milk was significantly higher than that provided by the other meal components. Milk contributed approximately 2 1/2 times the amount of calcium than the entrée component (26% planned; 24% served). The percentage contributions of vitamin A were similar for milk and the vegetable/fruit component (34% planned; 35% served) in School District A. Milk provided approximately the same percentage of calories as the grain/bread component.

The vegetable/fruit component provided the majority of vitamin C (71 − 78%) in the meal. Menu 2 that included the peanut butter and jelly sandwiches provided less vitamin C in the served (71%) than the planned (77%) menus. The grain/bread component contributed approximately 20% of carbohydrate and less than 20% of calories, iron, total fat, and saturated fat. The miscellaneous component accounted for approximately 20% of sodium, total fat, and saturated fat. To meet the *Dietary Guidelines* of limiting the amount of sodium and reducing total fat and saturated fat to $\leq 30\%$ and $\leq 10\%$ of calories, respectively, menu planners must pay careful

attention to this component.

Table 2 presents the nutrient contributions of the five meal components for menus during Periods 1 and 2 in School District B. A comparison of the nutrient contents of the planned menus and the served menus showed that District B served significantly more vitamin A and total fat in Period 1 and significantly more calories, iron, vitamin A, protein, and total fat in Period 2 than was planned ($p < 0.05$). The total contents of all nutrients except vitamin C were greater in the served menus than in the planned menus.

The entrée contributed an average of 69% of the cholesterol, 59% of the total fat, 54% of the protein, 53% of the iron, 50% of the sodium, 48% of the saturated fat, and 40% of the calories in the planned menus. The entrée in served menus provided averages of 66%, 53%, 52%, 51%, 47%, 43%, and 39% of cholesterol, protein, iron, total fat, sodium, saturated fat, and calories, respectively. The average amounts of sodium, iron, protein, and total fat in the entrées were higher in District B than those in the planned and served menus for District A.

The nutritional contribution of milk was similar to that found for District A. The milk component provided an average of 66% and 63% of the calcium, 32% and 30% of the vitamin A, and 28% and 28% of the protein in the planned and served menus, respectively. The vegetable/fruit component contributed an average amount of 24% or more of the following nutrients: vitamin C (77% planned; 73% served), vitamin A (42% planned; 41% served), and carbohydrate (24% planned; 23% served).

The grain/bread component contributed approximately one third of iron and carbohydrate and one fifth of calories, sodium, total fat, and saturated fat in the planned and served menus during Periods 1 and 2. The average contributions for calories, sodium, iron, carbohydrate, total fat, and saturated fat of the grain/bread component were more in District B than in District A.

The miscellaneous component provided an average of less than 10% of all nutrients in the planned menus, but much higher percentage of sodium, total fat, and saturated fat contents in the served menu. The miscellaneous menu items contributed an average of approximately 20% of total fat and saturated fat. The dressing for the salads and dip for the vegetable sticks increased the fat content of the miscellaneous category.

According to an evaluation report (USDA 1998), implementation of the NSMP resulted in significantly lower amounts of total fat and saturated fat in the meals, even though the amounts provided continued to exceed the *Dietary Guidelines*. The NSLP lunches also provided significantly more calories from carbohydrate and less cholesterol than those before the implementation. To meet the *Dietary Guidelines*, the most efficient way to decrease fat would be to select a major meal component that contributes the most and make changes in that meal component.

## Conclusion and Application

The major nutrients provided by the entrée component in both districts and for the two time periods included cholesterol, protein, total fat, saturated fat, sodium, and calories. Milk was an important source of calcium and contributed approximately a third of total protein and vitamin A in the meal. If milk were not served in the NSLP, foodservice directors would have difficulty in planning menus that provided one-third of RDAs for calcium, vitamin A, and calories. This result supports findings of the Johnson et al. (1998). These researchers reported that only when students selected milk as the beverage in a lunch meal, they achieved their nutrient requirement for calcium.

The vegetable/fruit component was the primary source of vitamins A and C. The grain/bread component provided approximately 20% of the carbohydrates in the meal. If whole grain products are served, this component would increase the fiber content of the meal. The contributions of the miscellaneous components varied between the two school districts and between planned and served menus. Miscellaneous component including condiment contributed more in served menu than in the planned menu and influenced the sodium and fat contents of the menus. It was uncontrollable for students to have the type and amount of condiments consumed.

Menu planners can use the results of this study to enhance their knowledge of nutrient contributions of each meal component. This information would be useful to school foodservice directors when planning menus using NSMP guidelines, because specific components are not required to be served. Knowledge of the nutrient contribution of the five meal components can assist directors in planning menus that comply with *Dietary Guidelines* and nutrient guidelines of SMI. School foodservice directors and menu planners could decide to target a meal component or a specific menu item that needs to be replaced or modified. Knowing the amounts of total fat,

saturated fat, and sodium in an item would help the director decide whether to serve this item. The types and amounts of items served as condiments can impact the percentages of calories from fat, if reduced-fat dressing is not served. The sodium content of the meal also is influenced by the types of condiments served. In addition to the nutrient quality of the meal served, menu planners should consider the acceptability, production capacity, and cost when determining items to include in the menu.

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