AN ABSTRACT OF THE THESIS OF

Russell Long for the degree of Master of Science

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Title: Food, Energy, and Nutrient Content of Food Pyramid Choices Menus, as Offered and as Eaten by Third Graders.

Abstract approved : _____

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This was an observational study of the food and nutrient contribution of lunches in the Food Pyramid Choices Menu system as offered to and eaten by 93 third graders participating from two schools in the Reynolds school district in Oregon. In response to current public health concerns in the U.S. and the emphasis on diets of moderation rather than simply nutritional adequacy, this study focused on the total and saturated fat content of the lunches offered to and eaten by third graders. In the Food Pyramid Choices Menu system, children are allowed to select their own lunches from a variety of entrees, milk, fruits, vegetables, and grain products. The meals as offered to the children were calculated as the mean amount of each food offered to each student in the school. Nutrient analysis for the average lunches as offered was done with Nutrikids (Lunchbyte Systems, Inc.) nutrient analysis software. One week of lunches were analyzed and averaged over the week. The meals as eaten were determined for each child by measuring the foods selected by each child, and subtracting the amount that was leftover by that

child. The nutrient analysis for each child's lunches, as eaten, was averaged over the number of days that each child ate lunches while participating in the study. The nutrient content of lunches was analyzed using ESHA's Food Processor. Each student's data for each day was averaged over the week and then with data from all the students participating to arrive at the mean daily food and nutrient intakes. The lunches as offered and as eaten had total fat contents of 33% and 35% of total energy, respectively. The lunches as offered and as eaten both had saturated fat contents of 13% of total energy. It was evident that the third graders ate lunches that, on average, contained a higher proportion of energy from total fat than did the lunches as offered. The lunches as offered contained on average 40.5 mg of vitamin C and 434 RE of vitamin A. The lunches as eaten contained on average 22 mg of vitamin C and 288RE of vitamin A. Though the lunches as eaten were lower in these vitamins than the lunches as offered, the amounts of vitamin C and A eaten were still significantly greater than the National School Lunch Program standards for vitamins C and A in school lunches of 15mg and 224RE, respectively. The mean nutrients analyzed in the lunches as eaten were significantly less than the mean nutrients that were analyzed in the lunches as selected, including: energy, carbohydrates, protein, total fat, saturated fat, protein, total and saturated fat as a percentage of total energy, cholesterol, fiber, vitamin A, vitamin C, fiber, calcium, iron, sodium.

Food, Energy, and Nutrient Content of Food Pyramid Choice Menus, as Offered To and as Eaten By Third Graders

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APPROVED:

Major Professor, representing Nutrition and Food Management

Head of Department of Nutrition and Food Management

Dean of Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Russell Long, Author

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INTRODUCTION

The Oregon Department of Education, Child Nutrition Division, has implemented the Food Pyramid Choice Menus (FPCM) in Oregon schools to provide school lunches that better meet the Dietary Guidelines for Americans. A FPCM lunch offers a selection of entrees, fruits, vegetables, grains, and milk.

The current school lunch guidelines for meals offered to third graders as mandated by the School Meal Initiative for Healthy Children (USDA: Federal Register, 1995) include 30% or less of total energy from fat and less than 10% of total energy from saturated fat, as well as meeting 1/3 of the RDA for children ages 7 - 10 for energy, protein, calcium, iron, vitamin C, and vitamin A. The Dietary Guidelines for Americans also recommend a diet moderate in sodium and cholesterol, and rich in dietary fiber for Americans two years of age and older (USDHHS, DGA 1995).

Traditionally, schools have offered a fixed menu for lunch. In the FPCM system the children have a variety of foods from which to select their lunches in hopes that this will lead to their selecting and eating healthier lunches. One of the objectives for this study was to determine what was offered on average to third graders in a school serving FPCM. We wanted to compare the food, energy, and nutrient content of the lunches as they were eaten by third graders to the content of lunches offered and to find out how close they came to current National School Lunch Program (NSLP) standards.

The first hypothesis was that the Food Pyramid Choice Menu lunches as they were eaten by third graders would not meet the Dietary Guidelines for Americans (USDA 1995) for total and saturated fat. The second hypothesis was that the mean daily percent of total energy from fat and saturated fat in the FPCM lunches as eaten would be higher than the mean of those same lunches, as offered, for the same week. Hypothesis three was that the average daily amounts of vitamin C and vitamin A would be smaller in the lunches as eaten for one week than in the same lunches as offered for the week. Hypothesis four was that among the menu components: entree, milk, bread, fruits, and vegetables, children would eat the greatest proportion of the entree and milk components offered, and the smallest proportion of the vegetable items offered.

LITERATURE REVIEW

Nutrition Goals of the National School Lunch Program

Over the years, dietary requirements for school lunches have changed, from a focus on nutritional adequacy to an approach of nutritional moderation and balance with the prevention of chronic illness in mind. In 1946 the National School Lunch Program (Dwyer 1995) was authorized, its purpose being to "safeguard the health and well being of the nation's children by providing them with nutritious foods and to support farm income by increasing the consumption of domestic agricultural products."

Currently, major nutrition concerns are that the American diet is too high in total fat, saturated fat, and sodium, and too low in complex carbohydrates and fiber (Kennedy and Goldberg 1995). The Surgeon General's Report on Nutrition and Health warns that over-consumption of fat compromises the health status of the public in this country (USDHHS, 1988).

The Morbidity and Mortality Weekly Report (USDHHS 1996) states that "some physiological processes that lead to chronic disease begin in childhood". The report notes that coronary heart disease, cancer, strokes, diabetes, high blood pressure, overweight, and osteoporosis have dietary risk factors. With only 16% of children ages 6-11 and adolescents ages 12-19 meeting the recommendation for total fat intake, there is a need for schools to help children maintain healthy eating habits (USDHHS 1996). This report also notes that children may understand the concept that they are supposed to decrease their fat intake but are unclear on the particular food choices that may be low in fat. A

recommendation was given to integrate comprehensive nutrition education and promote healthy eating at school as well as at home, combined with a school health program.

The National Health and Nutrition Examination Surveys (Troiano et. al. 1995) found that the occurrence of overweight children between the ages of 6 and 17 increased by 11% from 1988 to 1991. The definition for this value of being overweight was body mass index at or above the 95th percentile for 6 through 17 year olds, from cycles two and three of the third National Health and Nutrition Examination Survey. When the 85th percentile was used the incidence of overweight increased by 22%. While it is difficult to understand the reason for the increase in overweight children it is clear that there is and will be an increasing need for treatment and a need to focus on primary prevention.

In the Bogalusa Heart Study, dietary intake of 10 year olds was monitored over time (Nicklas et. al. 1993, Nicklas et. al. 1996). Since the study began, in 1973, the percent of children eating a diet that is greater than the recommendation for total fat has decreased though the prevalence of overweight children has increased, and still very few actually meet the recommendations for total fat intake. The study also showed that children consuming a diet high in complex carbohydrate (> 55% of total energy) consumed diets lower in fat, saturated fat, cholesterol, and sodium (Nicklas et. al. 1993, Nicklas et. al. 1996).

The School Nutrition Dietary Assessment Study (Dwyer 1995) states that 1 in 10 children get two of their weekday meals from school and over half of the children get at least one meal from school a day. Ninety nine percent of public schools nationwide participate in the NSLP, and an average of 56% of the students in these schools have school lunches on a regular basis. Many of those have school breakfasts as well (Moffitt

1995). It is easy to see that meals served at school may provide a large portion of the food that many children eat on a daily basis and how important the nutritional impact of these meals is. This makes school lunch a necessary place to effect changes in eating patterns.

Actual dietary intakes from lunch of 846 6-10 year old NSLP participants (Devaney et. al. 1995) show that these children consumed on average 34% of the RDA for total energy, 101% of the RDA for protein, 36% of the total energy from fat, and 14% of total energy from saturated fat, and 48% of total energy from carbohydrate. They consumed on average more than the target 1/3rd RDA for the nutrients: Vitamin A and C, thiamin, riboflavin, niacin, vitamin B-6, folate, Vitamin B-12, calcium, iron, phosphorous, magnesium, zinc. They consumed 78 mg of cholesterol and 1313 mg of sodium, compared to the recommendations of less than 100 and 800 mg respectively.

Nutrition Guidelines for School Lunch

Current School Lunch guidelines are designed to promote dietary patterns that will help reduce total fat, saturated fat, and sodium, and increase consumption of complex carbohydrates and fiber, in hopes of creating eating habits in children which will help prevent obesity, heart disease, and some forms of cancer, prolonging the years of good health.

The National School Lunch Program is administered by the U.S. Department of Agriculture. The current School Lunch guidelines are set forth in the Child Nutrition Programs: School Meals Initiative for Healthy Children; Final Rule (USDA, Fed Register

1995). These guidelines, state that daily lunches as planned, on average over a week's lunches must include one third of the Recommended Dietary Allowances (NRC 1989) for protein, calcium, iron, Vitamin A, and Vitamin C, and energy based on appropriate age group, and must meet the applicable recommendations of the 1990 Dietary Guidelines for Americans of total fat and saturated fat. The minimum nutrient levels for the lunches on a weekly average for the age group 7 - 10 years are: 667 kcals, total fat as a percent of total food energy not to exceed 30%, saturated fat as a percent of total energy to be less than 10%, 9.3g of protein, 267mg of calcium, 3.3mg of iron, 233 RE of Vitamin A, and 15 mg of Vitamin C. The School Meals Initiative for Healthy Children also includes a recommendation for a reduction in the levels of sodium and cholesterol, and an increase in the level of dietary fiber served, although no specific amounts are given.

Other Dietary Recommendations

The *Dietary Guidelines for Americans* (DGA) (USDA 1995) are broad recommendations to Americans for macronutrients as well as recommendations to eat a variety of fruit, vegetables, and grains. The Dietary Guidelines for Americans are recommendations for all Americans age two years and older (USDHHS, DGA 1995).

The Dietary Guidelines for Americans gave broad recommendations aside from total and saturated fat intake. They encourage a diet of variety using the Food Guide Pyramid as a guide including: 6 - 11 servings a day of bread and grains, 2 - 4 servings a day of fruit, 3 - 5 servings a day of vegetables, 2 - 3 servings a day each of the milk and the meat, beans, and nuts groups, and use of fats and oils sparingly. The DGA

recommend moderation in sodium and simple sugar intake along with total fat and saturated fat intake less than 30 % and 10 % of total energy , respectively (UDHHS:DGA 1995). The DGA also encourage healthy lifestyles with the proper balance of diet and exercise.

The School Nutrition Dietary Assessment Study (Burghardt and Devaney 1993), a national study of school lunch programs serving traditional fixed menu school lunches showed that the NSLP for 515 elementary, middle, and high schools offered lunches that provided, as an average, adequate amounts of kilocalories, protein, Vitamin A, Vitamin C, Vitamin B-6, calcium, iron, and zinc, when compared to the recommendations of 1/3 the current RDA (NRC 1989). This study also reported, however, that lunches served did not meet the recommendations for fat or carbohydrates. The average fat content of lunches in 278 elementary schools, as offered, in 1992 was 37% of kcals and saturated fat content was 15% of total kcals. Carbohydrates also failed to meet the goal of 55% or more of total kcals, with a level of 47% in the lunches (Burghardt et. al. 1995).

Fat Content of School Lunches

A common goal of the NSLP and the Dietary Guidelines is to decrease the amount of fat that is in a school lunches (USDHHS 1990, Hurd et. al. 1996). The School Nutrition Dietary Assessment Study conducted in 1992 indicated that the primary reason for lunches being higher in fat than recommended in 481 of the 515 schools in the study was that the entree was high in total and saturated fat (Dwyer 1995). They also found that servers had discretion in adding butter to items when they were being prepared. Also two percent and whole milk were offered rather than lower fat varieties (Dwyer 1995).

These were some practices that contributed to the high fat content of the lunches. The low fat meals served in 34 of 515 schools (those under 32% of energy from fat) included less ground beef and more poultry in the entrees, fewer serving of French fries, more servings of bread and fruit or juice, and more desserts of the gelatin/pudding type rather than high fat cakes (Dwyer 1995).

One study showed that decreasing the total fat content of a school lunch to 29% for three days in a fifth grade class lowered the total fat intake for the entire day without a change in the caloric value (Krupin and Georgiou 1993). This lowered total fat intake was accomplished primarily by substituting carbohydrate for some fat, while protein intake remained the same. The low fat lunches served over this three day period provided 28% of calories from fat, significantly less that the regular lunches with a higher fat content of 40% of calories from fat. Low fat intake at lunch was compensated for by an increase in higher fat snacks in the hours following the lunch, however fat intake for the entire day was still significantly lower when eating the lower fat lunches than when eating the higher fat lunches.

School lunches designed with the Dietary Guidelines in mind combined with nutrition education may lead to better eating habits of elementary children that will carry on into later years, having a positive effect on diet-related health problems later in life (Nicklas et. al. 1996, Newman et. al. 1986, USDHHS 1988, USDHHS 1990, USDHHS 1996, Freedman et. al. 1988, Newman et. al. 1991)

Reducing Fat Content of School Lunches

Reducing fat in school lunches while maintaining adequate caloric value as well as the students interest can be a difficult task. If students are not interested in eating school lunches then the nutritional benefits that the lunches provide are not obtained. The FPCM system aims at attracting students to eat a healthy school lunch.

When total fat is reduced in school lunch the total kilocalories may fall below the NSLP requirements. Some concerns have been raised in the past as to whether low fat diets for children may be detrimental to their growth (Kennedy and Goldberg 1995, Olson 1995). In these studies it was found that low fat intake was often associated with low caloric intake and that the low caloric intake was the main reason for inadequate growth of children in these studies (Kennedy and Goldberg 1995).

The Bogalusa heart study (Nicklas et. al. 1993 1996, Kennedy and Goldberg 1995) also shows that while lower fat lunches do contain fewer kilocalories, the low fat lunches do fall within the range of appropriate kilocalories. The growth patterns of children in the long term study eating low calorie and low fat lunches versus higher fat lunches, were similar despite their varying fat intakes (Nicklas et. al. 1993 1996, Kennedy and Goldberg 1995). Children in the Bogalusa Heart study who consumed high carbohydrate diets were found to consume more fruits, breads, grains, milk, and dessert, while the children with low carbohydrate intake ate more meat (Nicklas et. al. 1996).

Since the School Nutrition Dietary Assessment Study (Dwyer 1995) reported that school lunches were high in fat primarily because of the entree and milk components of the lunch, changing the entree and milk selections to make them lower in fat along with more

offerings of bread, grains, fruits, and other carbohydrates should help reduce the fat content and percent of total energy from fat in the lunches. Another way to decrease the fat in the meals is to replace high fat desserts with lower fat ones. These ideas have been tried and show a positive acceptance by students (Borja et.al. 1996, Whitaker et.al. 1994, Capper et.al. 1990, Garey et.al. 1990, Sandoval et.al. 1986, Snyder et.al. 1996).

Food Pyramid Choice Menus

In an effort to better meet the NSLP guidelines, the Oregon Department of Education, Division of Child Nutrition Programs, has implemented the Food Pyramid Choice Menus (FPCM). Their purpose was to better meet the NSLP standards which include decreasing the total and saturated fat offered to 30% or less and less than 10%, respectively of total energy, and increasing carbohydrate offered to 55% or more of total energy. At the same time a decrease in food waste was expected.

The Oregon Department of Education, Child Nutrition Division gives the following guidelines to the schools that participate in the FPCM system: three to seven healthy entree choices, one being vegetarian; six to ten fruits and vegetables, fresh, frozen, dried and/ or canned; three or more grains, flavored and un-flavored milk (FPCM 1996). The FPCM system also motivates schools to participate in nutrition education offering information and exercises for the teachers' use which emphasizes the Food Guide Pyramid, variety, and moderation.

The FPCM system follows the USDA requirement that children choose at least three menu components among milk, entree, fruit/vegetable/juice, and bread/grain. Two of the selections must be a milk and an entree selection. The entree can be either a single

food or a combination of foods that are offered as the main course. Two or more servings of fruit and or vegetables must be offered. A minimum of one serving of enriched or whole grain bread or other grain product must be offered.

The nutrient contribution of a school lunch can only include what is actually consumed. Waste of food contributes no energy or nutrients and adds to the cost of the lunches. The School Nutrition Dietary Assessment Study suggests that allowing the students to choose their own food may decrease food waste without a large effect on the average dietary intake (Dwyer 1995). The choices offered in the FPCM program may help reduce waste as well as help develop healthy dietary habits at an early age. Preliminary waste and food disappearance observation done by the Child Nutrition Programs division of the ODE indicate that waste is down considerably, as well as an increase in fruit and vegetable consumption (ODE 1995).

Getting the students involved in the selection of their own lunch may help increase their satisfaction as well as increasing their total energy intake and their intake of fruit, vegetables, and grain products, because the children may choose what they want. Empowering the students to choose a meal in this manner coupled with menu components that are reoccurring daily, may result in less food waste when compared to the previous fixed menu service system, and expands options such as variety of fruits and vegetables that are offered. Salad bar type service seems to be popular with elementary students. The School Food Service Journal reported that salad bars in schools help combat the competition from fast food and increase students' participation in the school lunch program (School Food Service Journal, 1986). A study done on the characteristics of children who can select either a higher or lower fat entree showed that regardless of race

or family income children learned to eat better as they got older and by developing habits (Whitaker et. al. 1994). Kindergarten students selected low fat entree lunches 27% of the time. This rate increased in each successive grade to 33% for fifth graders. Girls tended to select the low fat entree more frequently and more increasingly by age, than the boys. Other factors positively influencing consumption of lower fat lunches seemed to be the education level of the mother, or if there was a person in the home with high blood cholesterol.

The FPCM system was initiated in Oregon during the 1994-1995 school year, with about 23% participation among elementary schools by the end of 1996. The next step in evaluating the FPCM system was to determine the energy and nutrient content of these lunches as they were planned, as well as selected and eaten.

Assessment Methodology

In this study we were seeking to find the mean daily nutrient content in the school lunches as offered and as eaten over a week's time. A weekly average (USDA: Federal Register 1995), is used due to the high degree of variability of nutrient content from day to day. It was noted in previous studies(Jackson et. al. 1976) that a period of 3 to 4 days of data collection of a small group is sufficiently representative of a typical dietary intake and more accurate that one day of data collection. In this study we chose three days of complete data as the minimum standard for including a particular student in the study's data.

Methods of data collection for nutrition assessments range from dietary recall or interviews and food records to on site observation to collection of planned and usual

menus. The School Meal Collection and Documentation Methods in a Multi-site Study (Ebzery et. al. 1996) compares these methods. Due to the constraint of time and money for data collection, duplicating and weighing usual menus selected by each child is logistically difficult and too labor intensive. Methods like this may be highly accurate, but they are impractical due to time constraints as well as the food costs involved. Interviews and diet recalls are less accurate because they do not provide accurate portion sizes but provide easily accessible information.

To have the best accuracy within time and funding constraints we used a variety of data collection techniques. By weighing portion samples in several known sizes and quantities in advance we were able to estimate the portion size of a food item and record it very quickly allowing us to later evaluate its weight and nutrient content. After the meal was over we determined the amount of food leftover by weighing each food item left on a tray. Since more time is available after the students have finished eating, we could weigh the leftover food portions, subtract them from amounts selected, to have a reasonably accurate account of the amount of each food eaten. This method had greater consistency throughout data collection because it was completed by the researchers and did not rely on kitchen staff or students. The method of data analysis is described in more detail in the methods section.

METHODS

Approval

Approval for this study was granted by the OSU Institutional Review Board for Human Subjects. Permission was then obtained from the Oregon's Reynold's School District Superintendent, the district Food Service Director, the principals at Glenfair and Troutdale Elementary Schools, the kitchen workers at the two schools , the teachers who were involved, the students, and their parents. The permission letters and informed consent forms are located in appendices A and B.

Selection of Schools

All third grade classes from two of the schools in the Reynolds school district were chosen as the study sample. There were two third grade classes from the Troutdale School and three third grade classes from the Glenfair School. Third graders were chosen for several reasons; in part, their willingness to participate; likelyhood that they would be less influenced by being in a study than older children; their ability to understand instructions in comparison to younger children; and the fact that there are fewer differences in food preferences and consumption between genders at that age than among older children (Whitaker et. al.1994, Kennedy and Goldberg 1995). These schools were also chosen because they represent about equal proportions of students getting free, reduced, and full price lunches. This insured that children from families with a variety of income levels would be included, since food preferences may differ with family income

(Whitaker et. al.1994, Kennedy and Goldberg 1995). The Reynolds School District was chosen in part because the district had implemented the FPCM prior tothedata collection.

Participation

The number of students that responded positively to the permission forms was 103 out of a total of 140 students in five third grade classes at two schools in the Reynolds School District. Whomever wanted to participate were allowed to, though only those for whom we had three or more days of complete data were included in the analysis. There were students who agreed to participate but who were absent on one or more days during the week of data collection. There were some who participated but managed to evade the researchers who were collecting the trays, so we had data for waste but no data for selected in a few cases. There were some who emptied their trays in the trash before we could record the leftovers. The fact that they did not have to throw away their leftovers because we collected them, seemed to be one of the main reasons why many students agreed to participate! Usable data was available for 93 children, 83% of the total willing to participate.

Data Collection for Meals as Planned

Due to the self selection of individual food items in the FPCM system, each lunch selected was unique in food and nutrient content. The week's lunches, as planned, were defined as the total food planned for each day divided by the number of children to be served. The menus were centrally planned by the district food service director. This made

the menu items at each school the same, however the quantity and recipe for each food varies by the preferences of those at each school. The same one week's menus, as planned, were averaged over the two schools. Menus and recipes for every food item served were provided over one month in advance. The planned number of servings per food item on the menu as well as planned serving sizes were obtained two weeks prior to data collection. The foods provided on the menu for the week of data collection are in appendix C and a sample recipe form that was used for each food item in the menu is found in appendix D.

Data Collection for Meals as Selected and Eaten

To prepare for the data collection, data collection forms were designed to record the portion amounts of the food items as they were selected and eaten (Appendices E, F) . To determine the speed and accuracy of the data collection process, a pilot study was conducted of data collection methods on about 20 third grade lunches at a Corvallis school about a month prior to the data collection for the project. The researchers involved in the data collection process of this study participated in the pilot study to validate the data collection methodology and to gain accuracy among the data recorders. There were four data recorders who participated to determine agreement in estimating the same food samples chosen by students in the pilot study school. This pilot study also helped us make minor changes in the data collection form, as well as procedures, so that during the study, things would run smoothly.

The data for this study were collected for the same full week of school lunches at both schools in February of 1997. On the morning of each day of data collection, samples of all foods prepared for lunches were pre-measured. For food items that could be counted as units, five samples of each were weighed to obtain an average weight for each item in grams. These items included: the entree selection, the hot vegetable selection, bread, crackers, rolls, milks, grapes, apples, oranges, pears, banana halves, carrot and celery sticks, broccoli and cauliflower pieces, beet strips, pickles, sunflower seed packages, and cupcakes (Appendix G).

For items that were selected in volumes instead of "each" as a quantity, several pre-measured portions were laid out on trays for visual representation of known volumes and were used for comparison to the quantities that the students selected. Five samples of each volume for each item were weighed and each volume was displayed on trays. These foods included: fruit salad, cranberries, pineapple chunks, salad greens, and all the condiments - dressings, mustard, ketchup and butter. The trays that were used for the sample portions were the same as the trays used by the students, so that quantities that were placed within a tray partition could be compared with better accuracy.

Children served themselves condiments such as ketchup and ranch dressing by dispensing the amount desired from pumps into paper portion containers of known quantity. Pre-portioned samples of these condiments were displayed in varying quantities both directly on trays and in the portion cups to be able to compare the volume selected with better accuracy. Typical pre-measured portions of condiments were teaspoon, tablespoon, and quarter and half cup volumes.

During the data collection process there were two research assistants recording the lunches after the children had selected them. The pre-measured portions of the items to be served each day were placed in front of the data recorders for visual reference during the data recording period.

The classes that participated went through the lunch line with the other children in the school, but sat together as a class. This was not any change for them. Sitting together as a class insured more accurate results for the food records. With each class sitting together, food exchange was limited to that between children in the participating classes. Consider if a child did not want his milk and a student next to him drank it, then the data for these two individual children would be misrepresented, however, the mean daily average of the lunches as eaten was represented correctly. Two of the five classes participating ate in their classrooms regularly and did so during the study.

The tray of every student in the project was identified by a number corresponding to their name. Before lunch was served, the trays, along with the identifying numbers and a name tag, were taken to the classrooms instead of the children picking up a tray at the start of the line. When the students came to the lunch room they chose their meal in the same manner they had been accustomed to.

After the lunches were selected, the children handed over their trays for 30 seconds to two minutes at most to researchers. Trays were taken out of sight and the amounts food items selected were estimated by visual comparison with pre-measured samples and recorded. Data recorders had to work fast due to the lunch rush of a particular class eating all at one time. The menu components were documented; the entree and type of milk were recorded: the amounts of fruit/vegetable/grain/condiment

bar components were estimated by volume or number and recorded on the preprinted data collection forms (Appendices E,F). After the data were recorded the research assistants returned the trays to the appropriate children for them to eat.

Children had been previously instructed and reminded to leave their trays at the table they sat at or in their classroom after finishing their lunch. The research assistants retrieved the trays and brought them back to the kitchen to record the food waste. The waste was recorded for each child's lunch by weighing each food remaining in the tray with an Ohaus portable advanced electronic balance, CT series scales, measuring to the nearest half gram. Research assistants used spatulas to scrape food particles and salad dressing from the trays onto the scales. Each child's number was on a sticker stuck to the bottom of the tray, to double check with the name tags that were on the top of the tray, in the event of their getting lost or switched.

Leftover food items were generally easy to match with the original food category selected (e.g. part of the entree, or a carrot). The only leftover items that were difficult to match with items selected were salad items such as dressing mixed with the salad and condiments on the leftover hamburger. There was the benefit of having recorded the salad dressing and lettuce separately in the meals as selected. The children were instructed to serve themselves dressing into the portion cups, and they followed directions exceptionally well. None of the children served themselves salad dressing directly onto the salad as they normally did. When the waste from the lunches was recorded and there was dressing on the salad, the bulk of it could be separated. Typically it was a portion of dressing with a piece of lettuce in the middle in which case the lettuce was pulled out and the dressing was scraped off. After separating the food items, they were individually weighed and

recorded. In the case of mustard or ketchup on a bun, we estimated the volume of mustard, such as a teaspoon, then we subtracted the known weight of that teaspoon of mustard from the weight of the bun with the mustard on it. On Friday of the week of data collection there was a cupcake that was served in a package. When a student had selected a cupcake and the returned tray contained no cupcake wrapper, an assumption was made that the children consumed the entire cupcake. This assumption was based on the observation that many of the trays were returned with cupcake wrappers with no waste from the cupcake itself.

Data collection forms in appendix E and F were made for each individual child for the portions of the lunches selected and wasted. All the food items offered each day were printed on each data collection form. The quantity or volume of each food item selected was recorded. After lunch the waste from each food item was weighed and recorded in the appropriate column. Each student's forms, one for the selected and one for the eaten portion of the data, were matched together by student number. The data on leftover foods were subtracted from the data on foods selected for every food item to find the amount of each food item that was eaten.

A NETPRO trainer (Nutrition professionals on staff with the Oregon Department of Education, Child Nutrition Division) assisted with the data collection at both schools.

Data Analysis

Recipes and package information were used to analyze the nutrient content for every food that was offered (Appendix D). The food items within each food category on the menu (Appendix C) were weighted by the number of servings of each planned so that

the nutrient analysis for each food category represents the actual proportion of each food in that category which was planned. The weighted averages for energy and nutrients for each food category were summed and then the two schools were averaged over the five days of the week.

The energy and nutrients analyzed were compared to the standards set by the School Meals Initiative for Healthy Children (USDA:CNP 1995). These guidelines do not provide specific requirements for cholesterol, sodium, and dietary fiber. A decrease in cholesterol and sodium and an increase in dietary fiber is recommended. The standards used to evaluate cholesterol and sodium were the target levels of 100mg and 800mg, respectively, used in the School Nutrition Dietary Assessment Study. The dietary fiber offered, selected, and eaten in this study was compared to the mean fiber intake of 7 grams found in 278 elementary schools in the School Nutrition Dietary Assessment Study (Burghardt et.al. 1995). This is higher than a recommendation of "age plus 5 grams per day" (Williams C.L. 1995) or 5 grams of fiber for lunch of a 10 year old.

For analysis of the menus as planned, Lunchbyte software systems Nutrikids program was used. Any missing values for nutrients in Lunchbyte's Nutrikids software were added from actual labels or ESHA's Food Processor database. Nutrikids software is designed specifically for menu weighting and analysis of meals in school lunch. The data base is not as complete as ESHA's Food Processor for some nutrients. If a food label was found for an item, then the comparable item or an average of comparable items were found in The Food Processor and a particular nutrient missing from Nutrikids could be entered.

The nutrient content of lunches as selected and eaten was analyzed using the Food Processor nutrient analysis software. To insure consistency between the nutrient analysis of lunches as offered and as selected and eaten, the Nutrikids nutrient analyses for the lunches as offered were re-entered into the Food Processor software as new food items, thereby adding each food offered to the Food Processors data base. This enabled valid comparison of the nutrient content of the lunches as offered with those selected and eaten.

We decided to include data only from students for whom we had complete data for three or more days during the week. Complete data means that there were data for foods selected and leftover for each child. As stated earlier, sometimes a child might eagerly sit down to eat before the selected portions could be recorded. The number of students that had full data for three or more days during the week of data collection ended up to be 93 students.

For each student, a separate file was entered for each day for lunches as selected and eaten. The food quantities for the lunches as eaten were calculated by hand for each food item by taking the data for the food waste and subtracting that from the amount selected for each item for each child for each day. We entered the selected and eaten data into ESHA's Food Processor. Every food was analyzed for energy, carbohydrates, protein, total fat, saturated fat, cholesterol, fiber, vitamin A, vitamin C, calcium, iron, and sodium. There were no missing nutrient values for any food as offered, selected, or eaten.

The files from the Food Processor were converted to ascii files and then mainframe SPSS statistical software was used to obtain descriptive data and for statistical analysis comparing nutrients in the lunches as selected and as eaten. Each student's data was averaged over the number of days that he/she participated in the study to calculate their

daily averages for the week. Individual students' daily average nutrient data were then averaged for all the students from both schools to obtain the mean energy and nutrient content of lunches as selected, and for the same lunches as eaten.

The files were also aggregated by food category and analyzed for the nutrients contributed by each food category. The categories included the entree, milk, fruit, vegetable, bread and grains, condiments, and an 'other' category which included only sunflower seeds.

The evidence for accepting or rejecting hypotheses one through four was descriptive in nature. The energy content of the lunches as planned was based in menus from two schools. These can not be compared statistically to the distribution of data representing meals selected and eaten by 93 children. A t-test was used to detect statistically significant ($p<.05$) differences between the energy and nutrient content of lunches as selected and eaten by third graders.

Limitations

Some of the limitations of this study include that the sample of students was not random and the school and district chosen for the sample were not random. Portion cups that children had to use to put dressing in was a change from their normal routine and therefore was a limitation. Our presence while collecting data was a limitation that may have influenced the students. The Friday of data collection was Valentines day which affected the food choices of the students. There were weights of items that have non-

edible portions included in the weight and estimation of food volumes by pre-portioned comparisons. These were all things that posed limitations to the research.

The samples of schools were chosen because of the variety of students in the third grade classes in order to have a good representation of free, reduced, and full price lunches. The number of third grade students participating in the study that pay full price for the lunches was 48, 6 pay partial fees, and 38 are free lunches, one student's pay category was undetermined. Usually a school is in an area with the majority of the students either paying full price for their lunches or receiving free lunches. Reynolds School District was also chosen because it had implemented the FPCM system at least six weeks prior to data collection. Six weeks was desired because kitchen staff have noticed it takes several weeks for children to regulate their selection of foods to match their appetite. Because the students and the school were not chosen at random, we can not extrapolate the findings to a population larger than the third graders in the Reynold's School District.

The measurement of salad dressing selected and eaten presented complications due to the tendency for children to dribble little bits of ranch dressing all over everything on their tray. This makes precise measurements difficult. The solution arrived at was to have the children select the dressings into portion cups so that the data collection would be much more accurate, and then they could dribble it all over everything once they sat down to eat. This serving method may have led to selection of larger servings than usual. Having dressing dribbled all over the plate may make it look like enough, and cause a child to quit, whereas the dressing may appear to be a smaller quantity when in the portion cups resulting in a child selecting more than they normally might.

Non-edible skins of two food components, orange quarters and bananas were included in their weights as selected and leftover. This resulted in the nutrients for these items as selected, but not as eaten, being somewhat over-reported. The portions of bananas and oranges are served with the skin. They were weighed as selected, with the skins on. The leftover skin was weighed and the values were subtracted from the amount selected to determine the amount eaten for each child. The weight of the eaten portions of orange and banana were recorded and entered into the ESHA's Food Processor and are as accurate as the study allows. The weight of the selected portions were also entered into Food Processor but these weights included the skins when the nutrient database of the program did not include the skins. The difference in the weight from the non-edible portion of the orange accounts for a difference of about 10 mg of vitamin C per orange slice. The amount of vitamin C available per orange slice would be about 13 mg, whereas the amount of vitamin C was reported as 23 mg as selected. Approximately 51% of the vitamin C that was eaten came from the fruit component of the lunch. This would give a reported value of 134% of actual of the selected portion of vitamin C. The main nutrients that are over reported due to the inclusion of non-edible portions in the selected weights are vitamins C and A. This was not of great concern due to the results of the intake of vitamins C and A being much larger as eaten than the recommendations.

Another limitation was our presence in the data collection process. The food was taken out of sight of the children, this meant that they had to wait in line while we recorded the data. The researchers who were collecting the trays from the students were not wearing lab coats in order to minimize the feeling of being studied. Having to stand in line was out of the ordinary for the children so we tried to get through the trays of food as

fast as possible. The data collection for the wasted portion was done after the students were gone so that there was no influence by our presence or what we were doing with their food after they were done.

The Friday of data collection was Valentines day. The menu was modified on this day to include a cupcake. This was the only menu change, however it should also be noted that classes were throwing valentine parties with additional food that day. This undoubtedly influenced the meals that the children selected and ate. Since the meals were averaged over the week, this would lessen but not eliminate the impact on the meals. With frequent holidays and birthday parties among classrooms, this may not be far from a representative week.

Using pre-portioned and pre-measured food volumes was the fastest way to estimate food volumes on the trays with relative accuracy. The ideal way would be to have weighed each food item selected, but this was not possible in the FPCM system of individual choice in food selection.

RESULTS

Average Lunches as Planned, Selected, and Eaten

Table 1 is a summary of data on average daily lunches planned for and selected and eaten by third grade students, during one week, at two Oregon elementary schools. The first column of the table contains the daily energy and nutrient standards set forth by the USDA (USDA 1995) for school lunches, as well as by the Dietary Guidelines for Americans for total fat, saturated fat, and the American Diabetes Association (ADA 1994) for cholesterol, fiber, and sodium. One third the daily amount recommended by health authorities was used as the standard. The NSLP standards are for daily averages over a week's time.

The data for lunches as planned comes from projections of menus to be served during the study week. The menus were planned two weeks prior to the week of the study.

The data for the lunches as they were selected refers to all the foods in the amounts selected by the third graders. The data was collected as the students selected an entree, milk, and items from the fruit, vegetable, and bread variety bar.

The data for the lunches as eaten were calculated by weighing the plate waste from each food item on each child's tray and subtracting it from the estimated amount selected by that child. Each student's individual data was averaged over the week for the number of days he/she ate a school lunch. The weekly average for each child was then averaged together with the rest of the children in each school to give the mean nutrient content of the lunches as they were selected and as they were eaten by all third graders.

Table 1

Mean Daily Energy and Nutrient Content of FPCM Lunches Offered to, Selected, and Eaten by Third Graders During One Week.

NUTRIENT	USDA School Lunch Requirement	Average lunch as offered to third graders	Average lunch as selected by third graders n=93 ±Std. Dev.	Average lunch as eaten by third graders n=93 ±Std. Dev.
ENERGY(kcals)	*664*	695	**653 +/-108**	**462 +/-116**
CARBOHYDRATES(g)		94	**80 +/- 15**	**59 +/- 15**
% CHO (of total kcal)	*55 or more*[1]	54	**49 +/- 6**	**51 +/- 7**
PROTEIN (g)	*10 or more*	28	**26 +/- 4**	**18 +/- 5**
% PROTIEN (of total kcal)		16	**16 +/- 3**	**15 +/- 3**
TOTAL FAT (g)		26	**26 +/- 8**	**18 +/- 6**
% TOTAL FAT (of total kcal)	*30 or less*[1]	33	**36 +/- 6**	**35 +/- 6**
SATURATED FAT (g)		10	**10 +/- 3**	**7 +/- 3**
% SATURATED FAT (of total kcal)	*10 or less*[1]	13	**14 +/- 3**	**13 +/- 3**
CHOLESTEROL (mg)	*100 or less*[2]	42	**45 +/- 8**	**31 +/- 10**
FIBER (g)	*7*[2]	5.7	**4.4 +/- 1.5**	**3.1 +/- 1.2**
VITAMIN A (RE)	*224*	434	**395 +/- 347**	**280 +/- 290**
VITAMIN C (mg)	*15*	41	**33**[3] **+/- 21**	**22 +/- 14**
CALCIUM (mg)	*286*	465	**487 +/- 111**	**314 +/- 121**
IRON (mg)	*3.5 or more*	3.7	**3.4 +/- 0.8**	**2.5 +/- 0.8**
SODIUM (mg)	*800 or less*[2]	1162	**1061 +/-209**	**750 +/- 206**

1. School Meals Initiative for Healthy Children guidelines taken from applicable recommendations from the Dietary Guidelines for Americans, USDA/DHHS 1995.
2. An increase in Fiber intake, and a decrease in sodium and cholesterol is recommended by the School Meals Initiative for Healthy Children (USDA:CNP 1995). No specific level is specified. The SNDAS recommended a target lunch intake for cholesterol of less than 100 mg and sodium intake less than 800 mg. The average intake of dietary fiber by 6 -10 year olds in the SNDAS, 7 grams, is used as a comparison with our values (Burghardt et.al. 1995). Actual intake of 6-10 year olds in the SNDAS are 78 mg and 1313 mg for cholesterol and sodium, respectively.
3. Value for vitamin C as selected is somewhat overestimated due to measurement error, see page 24-25.

Fat content and contribution to the lunches compared to the DGA

The first hypothesis was that the FPCM lunches as they were eaten by third graders would not meet the DGA (USDA 1995) for total and saturated fat. The DGA (USDA 1995) recommendations are that 30% or less of the total kcals eaten be from fat, and that less than 10% of the total kcals eaten be from saturated fat. Table 2 shows that third graders consumed an average of 35% of energy from total fat and 13% of energy from saturated fat from their lunches. This means that the students, on average, did not meet these two DGA recommendations. The first hypothesis was confirmed.

Looking at the data from individual students, seventeen percent (16 of the 93) of the students did consume 30% or less of total lunch energy as fat and 15.1% of the students (14 of 93) consumed less than 10% of lunch energy as saturated fat. This also means that eighty two percent of the students ate lunches which failed to meet the DGA (USDA 1995) for percent of energy from total fat, and 84.9% ate lunches which failed to meet these recommendations for saturated fat.

Table 2

Dietary Guidelines for Percent of Total Energy from Total Fat and Saturated Fat Compared with the Mean Percent of Daily Energy From Total Fat and Saturated Fat in Lunches as Consumed.

NUTRIENT	DIETARY GUIDELINES for AMERICANS*	MEAN % of TOTAL KCALS CONSUMED PER LUNCH AVERAGED FOR THE WEEK n = 93	% OF STUDENTS THAT MET THE DIETARY GUIDELINES
TOTAL FAT	30 % OR LESS OF TOTAL KCALS	35% OF TOTAL KCALS EATEN	17.2 %
SATURATED FAT	10% OR LESS OF TOTAL KCALS	13% OF TOTAL KCALS EATEN	15.1%

* U.S. Department of Agriculture (1995) Nutrition and Your Health: Dietary Guidelines for Americans

Fat content and contribution to the lunches as eaten compared to lunches offered

The second hypothesis was that the mean daily percent of total energy from fat and saturated fat in the FPCM lunches as eaten would be higher than the mean of those same lunches, as offered, for the same week. Table three shows that the mean percent of energy from total fat and saturated fat in the meals as offered were 33% and 13%, respectively. The mean percent of energy from total and saturated fat in the meals as eaten were 35% and 13%, respectively. It was evident that third graders, on average, ate a greater proportion of energy from lunches as total fat than was in the average meal offered. They ate proportionately more of the fat in their lunches than the carbohydrate or protein. They ate, however, the same proportion of energy from saturated fat as was in the meals as offered.

Hypothesis two was confirmed for total fat consumption with a mean of 35% of total kcals coming from fat in the lunches as eaten, compared to 33% of total kcals from

fat in the lunches as offered. Hypothesis two was not confirmed for saturated fat. The mean percent of total kcals from saturated fat consumed (13%) was equal to the mean percent of total kilocalories from saturated fat in the lunches as offered.

Table 3

The Mean Daily Percent of Energy from Lunches as Offered and as Eaten by Third Graders During One Week at Two Elementary Schools for Total and Saturated Fat, Carbohydrates, and Protein.

Nutrient	Mean Daily % of Total Kcals Offered	Mean Daily % of Total Kcals Eaten n=93
total fat	**33%**	**35%**
saturated fat	**13%**	**13%**
% Carbohydrate	54%	51%
% Protein	16%	15%
Total	100%	100%

1. Nutrient standards for lunches are based on a daily average over one week of menus as planned.
2. Nutrient Analysis for lunches as offered: Nutrikids
3. Nutrient Analysis for lunches as eaten: ESHA's Food Processor

Vitamins A and C in the lunches as eaten compared to offered

Hypothesis three was that the average daily amounts of vitamin C and vitamin A would be smaller in the lunches as eaten for one week than in the same lunches as offered for the week. Table 4 shows that the mean values of vitamin C and A in the lunches, as offered for one week, were 40.5 mg of vitamin C, and 434 RE of vitamin A. The mean values of vitamin C and A that were in the lunches as eaten for the same week were 22 mg of vitamin C and 288 RE of vitamin A.

Hypothesis 3 was confirmed for vitamins A, and C. The mean amounts of vitamins A and C eaten from the lunches were less than the mean amount available per child.

Table 4

The NSLP Standards for Vitamins A and C Compared to the Mean Daily Amounts in Lunches Offered to and Eaten by Third Graders During One Week.

Nutrient	NSLP Standards1,2	Mean Amount in Lunches as Offered	Mean Amounts in Lunches as Eaten
Vitamin C (mg)	15	40.5	22
Vitamin A (RE)	224	434	280

1. U.S. Department of Agriculture, and Child Nutrition Programs: School Meals Initiatives for Healthy Children: Final Rule. Federal Register, Vol. 60, No. 113, June 13, 1995.
2. Nutrient standards for lunches are based on a daily average over one week of menus as planned.
3. Nutrient Analysis for lunches as offered: Nutrikids
4. Nutrient Analysis for lunches as eaten: ESHA's Food Processor

Proportion of Menu components eaten compared to offered

Hypothesis four was that among the menu components: entree, milk, bread, fruits, and vegetables, children would eat the greatest proportion of the entree and milk components offered, and the smallest proportion of the vegetable items offered. Calories were used as the measure of the amounts of food offered and eaten from each category. Table 5 shows the mean daily kcals in each food category in the lunches as offered and as eaten, and the percent kcals offered which were eaten from each category. The table lists the categories by rank from the highest to the lowest percent of offered kcals which were eaten. The exception was the 'condiment' and 'other' category which we have excluded from the ranking because they constitute a very small percent of the total energy. The

number of students that select each category varies. This was taken into account in the table such that the mean daily kcals eaten from each category were averaged for the total number of students in the study. The menu component whose consumption was highest was milk, with students consuming 83% of the mean calories offered from milk. The next highest consumption was that of the entree , at 73% of kcals offered. The lowest proportion consumed was from vegetables, at 38% of kcals offered.

Hypothesis 4 was confirmed. The milk and entree were consumed in the greatest quantities in proportion to the amount offered, and vegetables were consumed in the smallest quantity compared to the amount of total energy offered.

Table 5

Mean Daily Energy in each Food Category of the Lunches as Offered and Eaten in Descending Order by Percent of the Offered that was Eaten, Rank Excluding 'Condiments' and 'Other' Categories.

RANK	Food CATEGORY/ Total Students		MEAN DAILY KCALS OFFERED AT LUNCH	MEAN DAILY KCALS EATEN FOR ALL STUDENTS PER CATEGORY	PERCENT OF KCALS OFFERED WHICH WERE EATEN
1.	Milk	90 Students	86	71	83%
2.	Entree	93 Students	350	256	73%
3.	Bread	89 Students	106	70	66%
4.	Fruit	89 Students	88	49	56%
5.	Vegetable	57 Students	13	5	38%

1. Nutrient Analysis for lunches as offered: Nutrikids
2. Nutrient Analysis for lunches as eaten: ESHA's Food Processor

Energy and Nutrient Content of the lunches as eaten compared to selected

A two sided, one sample t test was performed comparing the mean amounts of energy and the mean of each nutrient selected and eaten for each student (Table 6, n = 93, df = 92) to determine significant differences, if any. A statistician was consulted on the data. A Wilcoxon Matched-Pairs Signed-Ranks test was done to further validate the results of the one sample t test. The data for the lunches as selected and eaten are listed in table 6 along with the mean difference between the amount of each nutrient eaten and selected. Statistical tests were run using SPSS UNIX software (Release 6.1). Significantly less energy and smaller amounts of every nutrient were eaten than were selected. Both statistical tests produced the same significant results.

Table 6

Mean Daily Energy and Nutrient Content of FPCM Lunches Selected and Eaten by Third Graders During One Week.

NUTRIENT	Average lunch as selected by third graders n=93 ±Std. Dev.	Average lunch as eaten by third graders n=93 ±Std. Dev.	Mean Difference between the lunches: selected minus eaten ±Std. Dev.
ENERGY (kcals)	653 ± 108	462 ± 116	130* ± 172
CARBOHYDRATES (g)	80 ± 15	59 ± 15	6* ± 8
PROTEIN (g)	26 ± 4	18 ± 5	15* ± 20
TOTAL FAT (g)	26 ± 8	18 ± 6	5* ± 8
SATURATED FAT (g)	10 ± 3	7 ± 3	2* ± 3
CHOLESTEROL(mg)	45 ± 8	31 ± 10	10* ± 14
FIBER (g)	4.4 ± 1.5	3.1 ± 1.2	0.9* ± 1.1
VITAMIN A (RE)	395 ± 347	280 ± 290	69* ± 137
VITAMIN C (mg)	33 ± 21	22 ± 14	7* ± 12
CALCIUM (mg)	487 ± 111	314 ± 121	120* ± 165
IRON (mg)	3.4 ± 0.8	2.5 ± 0.8	0.6* ± 0.9
SODIUM (mg)	1064 ± 209	750 ± 206	220* ± 296

* $p \leq .000$

1. Nutrient analysis done by ESHA Nutrient Analysis Software (ESHA Research, Salem, OR): The Food Processor
2. One-sample, two sided t-tests were used to detect differences in nutrient content of lunches selected and eaten. Analysis were done using SPSS UNIX software (Release 6.1)
3. Value for vitamin C as selected was somewhat overestimated in only the selected data due to measurement error, see page 24-25.

DISCUSSION

Nutritional Goals

The current direction of dietary recommendations for the National School Lunch Program is one of nutritional moderation. The Morbidity and Mortality Weekly Report (USDHHS 1996) reported that 16 % of children between the ages of 6 and 19 meet the recommendation of 30% or less of total energy from fat intake on a daily basis. We found that even when given several choices of fruits, vegetables, and grain products each day only 17% of the third graders met this recommendation from their FPCM lunches.

In comparison to the guidelines set by the School Meals Initiative for Healthy Children for school lunch (USDA Fed Register 1995), the mean intake of students in this study met the guidelines for Vitamins A and C, Calcium, Cholesterol, and Sodium, and Protein. The mean intake of students in this study failed to meet the guidelines for total energy, percent of total energy from carbohydrates, total and saturated fat, fiber, and iron. More than 80% had fat intakes from lunch greater than recommended. Refer to Table 1 in results, p28.

These specific recommendations of the School Meals Initiative are coupled with those of eating a greater variety of fruit, vegetables, and grains which are recommended by the Dietary Guidelines for Americans (USDA 1995) as well as other sources of advice for healthy eating such as the Healthy People 2000 initiative (Lewis et. al. 1994). The choices of foods that were available to the students in this study provided greater variety of fruits, vegetables, and grains than traditional non-choice school lunches.

The School Nutrition Dietary Assessment Study (Burghardt and Devaney 1993) showed that the NSLP for elementary, middle, and high schools offered lunches that provided on average, adequate amounts of calories, protein, Vitamins A and C, calcium, and iron when compared to current lunch guidelines. this study in comparison, showed that FPCM lunches were provided, on average, to participating third graders that also met these guidelines for calories and the same nutrients: protein, Vitamins A and C, calcium, and iron. In the School Nutrition Dietary Assessment study, the percent of calories offered in school lunches from carbohydrate, total fat, and saturated fat were 47%, 38% and 15% respectively. However, in this study the percent of calories provided to the students on average from carbohydrate, total and saturated fat were 54%, 33%, and 13% respectively. For the recommendations of 55% of calories from carbohydrate, 30% from total fat, and 10% from saturated fat, this study shows results closer to these recommendations than the School Nutrition Dietary Assessment Study. Assessed by 24 hour dietary recall, the students participating in the School Nutrition Dietary Assessment Study (Devaney et. al. 1995) said to have consumed percents of calories from carbohydrate, total fat, and saturated fat of 48%, 36%, and 14%, respectively. In this study the students consumed percents of calories from carbohydrate, total fat, and saturated fat of 51%, 35%, and 13%, respectively. This indicates that the lunches as eaten will be closer to the recommendations if the lunches as offered are closer to the recommendations.

Entree Contributes to Total and Saturated Fat Content of School Lunches

A common goal of the NSLP and the Dietary Guidelines is to decrease the amount of fat that is in school lunches (USDHHS 1990, Hurd et. al. 1996). The School Nutrition Dietary Assessment Study (Dwyer 1995) noted that the primary reason for the lunches being high in fat was due to the entree being high in total and saturated fat. The total and saturated fat in the entree portion of the lunches as offered to the students was 42%, and 18% respectively. This was a high percentage of fat considering 47% of the total energy offered by the lunch comes from the entree. The entrees of the lunches as eaten was the food category with the greatest proportion of energy from total and saturated fat content 40% and 17% of kilocalories, respectively excluding condiments and "other" category which contains sunflower seeds.

Food Pyramid Choices Menu

The new system of Food Pyramid Choice Menus allows children the freedom to select a meal made up of food components and quantities of their choosing. This differs greatly from the previous system of pre-portioned trays with identical meals served to each child. In the older system of tray service, a child was handed a tray with what was planned for that day. If they were not fond of a particular item in the lunch, then they would not eat it. In the FPCM system which offers a selection of about five entrees to choose from and a fruit and vegetable and grain bar, the children have the option to select the same foods every day or different foods every day, as they like.

This system also gives rise to great variability among the students in the energy and nutrient content of the lunches they select and eat. The planned quantity of total fat

per lunch per day was 33% of the total energy in the lunches. A student, however, could select a lunch with a greater proportion of its total energy from fat, and another student could select a lunch with only a smaller proportion of its calories from fat. A student may not eat the entire lunch that he or she selected. The student who selects a lunch with 30% of its energy from fat may actually eat a lunch providing 40% or 20% of its total energy from fat.

Hypothesis 1

The children ate lunches, on average, providing 35% of their total energy from fat and 13% of total energy from saturated fat. These mean values for the lunches as eaten did not meet the Dietary Guidelines for Americans (USDA 1995) of not more than 30% and less than 10% of total and saturated fat respectively. The range of total fat intake from lunch was from 19% to 53% of energy. Seventeen percent of the students did consume meals providing 30% or less of their total energy as fat. In a dietary intake study of NSLP participants (Devaney et. al. 1995), 846 6 - 10 year old children were found to consume 36% of their total daily energy from fat. Although the third graders in this study ate a greater proportion of dietary energy from fat than the 33% in the FPCM lunches as offered, they still ate a small proportion less of fat from their lunches than the national average of 36% of energy from fat daily. The students in this study selected lunches that contained 36% of total energy from fat, however, they ate lunches that contained 35% of their total energy from fat. In grams this was an average of 26 grams of fat in lunches as selected, or 234 of 653 total calories from fat, and 18 grams of fat in the lunches as eaten or 162 of 481 total calories from fat. We expected the children to eat a greater proportion

of their lunches from fat than was in the lunches they had selected. We expected high fat items such as the entree, or specifically the meats and cheeses from the entree, to be what the children chose to eat. It was a pleasant surprise to find that the students ate lunches that had less of the energy from fat (35%) than in the lunches as they were selected (36%). Looking at only the entree portion of the lunch, there was a difference of less than one half of one percent between the mean amount of energy from fat as eaten (40.7%) and the mean amount of energy from fat as selected (41.1%). This shows that the entree portion of the lunches were consumed in closer proportion to the way they were selected than the difference in the percent of fat selected and eaten from the lunch as a whole .

Hypothesis 2

The children ate lunches providing the same 13% of energy from saturated fat as in the meals as planned. This was more than the 10% that was recommended in the DGA (USDA 1995). Unlike the total fat, the percent of saturated fat in the meals as eaten remained the same as in the meals as planned. It was interesting though that the students selected meals containing 14% of energy from saturated fat, and then ate meals that provided saturated fat equivalent to that in lunches as planned. Expressed in grams this comes to: 10 grams of saturated fat in lunches as selected, or 90 of 695 calories in the lunches as planned, 10 grams of saturated fat as selected or 90 of 653 calories in the lunches as selected, and 7 grams of saturated fat or 63 of 481 calories in lunches as eaten. The School Nutrition Dietary Assessment Study (Devaney et. al. 1995) found 6 - 10 year olds to eat 14% of their total school lunch energy from saturated fat. Though the children in this study selected 14% of total energy from saturated fat, they ate 1% less of their total

energy from saturated fat. This indicates that they consumed less of foods containing saturated fat, such as milk, than they selected.

Hypothesis 3

The average daily amounts of vitamin C and Vitamin A offered for the week were 40.5 mg and 434 RE respectively. Vitamin C consumption was 22mg, a little more than half the amount offered. The mean daily corrected value of vitamin C that was selected was 24 mg, or about 85% of the amount offered. One hundred forty seven percent of the USDA school lunch standard of 15 mg per lunch for vitamin C was the mean daily amount of vitamin C eaten. Our students ate less than the 6-10 year olds in the NSLP study who reported consuming 59% of the RDA or 27 mg of Vitamin C from the school lunches (Devaney et. al. 1995). Though the students in the study, on average, ate only about half of the vitamin C offered and only two thirds of that selected, they still achieved an intake of vitamin C greater than the USDA standard. The USDA standard for Vitamin A in school lunches as served was 224RE. Third graders in this study were offered a mean daily amount of 434RE, almost two times the standard. They selected from this 385RE, and consumed 271RE, 62% of the amount offered. In comparison with the NSLP study whose 6 - 10 year olds reported an intake of 37% of the RDA or 251 RE from school lunches, the students consumed 38% of the RDA, almost exactly the same. (Devaney et. al. 1995). The mean daily value of vitamin A eaten was 121% of the USDA standard. The major sources of vitamins C were oranges and broccoli and the major source of Vitamin A was carrot sticks. The relative popularity of these and other sources of Vitamins A and C influences the amount of Vitamins A and C intake of the students. The

popularity of carrot sticks and orange slices are the primary reason that the amounts of Vitamins A and C eaten are over 100% of the recommendations.

Hypothesis 4

The Food Pyramid Choice Lunches were broken down into seven food categories for analysis: entree, milk, breads, fruits, vegetables, condiments, and other. Hypothesis four looked at food categories and the mean daily average proportion of each type of food offered that was actually eaten. On average for each day, all 93 students selected an entree, 90 selected a milk, 89 selected fruits and 57 selected vegetables. The number of third graders selecting each food category as well as the amount each selected had an impact on the average amount consumed from each food category. Since the process involves selection, the number of students selecting each category varies. All took an entree and almost all took milk, but categories such as fruit, vegetable, bread, and condiments vary considerably from child to child. These results are in agreement with previous research that shows that milk was typically consumed in greater proportion than the other food categories offered, 88% by NSLP participants (Gordon and McKinney 1995).

Assessment of Methodology

A sample of third graders was chosen in part because it has been shown there are fewer differences in caloric intake between boys and girls of the ages 6-11 (Kennedy and Goldberg 1995, Baranowski et. al. 1986). From our observation, it seems also that children in the third grade were not preoccupied with altering their eating habits to

influence the records of their diets, where as older children may be inclined to do so. The thoughts that seemed for-most on their mind was when could they get their food and when was recess! Older children's eating patters may be influenced by what they think a researcher may be looking for. Presence of the data collectors (wearing white lab coats) to the children was kept to a minimum, to avoid attention being drawn to the data collection process. The actual data collection was performed out of sight. At Troutdale it was in the kitchen, where children other than those helping serve, are not allowed. At Glenfair, it was done in the lunch room but behind two large movable chalk boards to block the view of the data collectors.

Data was used for analysis if we had sufficient data for three days or more during the week. Three days of averaged nutrient data gives an analysis closer to the typical nutrients in the students' diets than does only one or two days of data (Jackson et.al. 1986). To avoid the novelty of children being singled out to participate in the study, all the children that were participating in the study to begin with were treated as though they were still participating even if they were absent more than two days during the week. All the students in a class had a laminated name tag in fancy print that they were allowed to keep regardless of whether they were participating in the study or not. Several children kept theirs on the first day, even though we told them they would be welcome to them at the end of the week.

We think the methodology used proved to be fairly successful in accurately depicting the foods and amounts offered, selected and eaten. The data for the lunches as planned was as accurate as the Nutrikids analysis program allowed. All the recipes were entered and calculated on weighted averages of the foods served. The measurement of

leftover foods was the portion of the data collection most accurate due to the fact that all leftover foods were separated and weighed on a scale. The measurement of the lunches as selected relied on estimation more than the lunches as offered or the leftovers.

The method of weighing several samples of pre-portioned serving sizes of foods worked very well. When it appeared that students did not eat any of an item that they had selected, we could check the weight left on their tray with the average weight of the pre-portioned sample size. Occasionally the portion left on the tray weighed more than the estimated pre-portioned sample size. The eaten amount was counted, in this case, as zero, and not a negative number. There were variations of a few grams between each estimated food weight and volume and its averaged sample weight. This was to be expected due to typical variation between each food portion.

A number of circumstances were present to make the data collection go smoothly. The data collection would have been more difficult if more changes had to have been made from the children's normal patterns, such as if the children didn't already sit together as a class, or if a large majority of the class was not participating. The large number of food items that could be counted in quantity rather than volume helped the speed of data collection. In this type of nutrient analysis it was important to keep the setting as natural as possible, as we discussed with the salad dressings, food items of different shapes may appear to be a different volume to a child, and they may select according to the volume or amount they think they would like to eat.

Generalizability of Results

Since the sample was relatively small, and not randomly selected, the results can not be generalized to the population of Oregon third graders. Since the data for each child represents three to five days of a week, we can generalize that the lunches analyzed are representative of what those participating select and eat when offered. The sample consisted of all third graders from two schools in one district. From unpublished data (Georgiou 1997) on a study of elementary school lunches served by a random sample of Oregon elementary schools, we found that each school and district varied somewhat in foods and nutrients offered.

Summary

This research shows us that when children were given choices of foods as Food Pyramid Choices Menus lunches, they were capable of selecting and eating lunches that met most nutrient recommendations and came close to meeting energy and fat recommendations. The lunches that the students ate, on average, were only slightly higher in total fat than those lunches as offered. This may indicate that to achieve the desired intake of 30% or less of kilocalories from total fat, a lunch as offered may need to contain less than the recommendation.

Recommendations for Further Research

The results of this study correlate with the trend of studies that show that though fat intake may be on the decline, more emphasis needs to be put on methods of reducing fat content and intake from school lunches (Nicklas et. al. 1996).

More data could be collected on demographic characteristics of students to determine their influences, if any, on school lunch intake. Since a large number of schools and students also participate in school breakfast, a study might include both School Breakfast and School Lunch and look at the comparative nutrient contributions of each. This type of study could be combined with information from diet records taken on what the same children eat during the rest of the day.

CONCLUSION

Third graders offered FPCM lunches containing total and saturated fat of 33% and 13%, respectively, ate 35% of energy from total fat and 13% of energy from saturated fat, more than recommended by the DGA. Third graders selected and ate FPCM lunches that on average contained a higher proportion of total fat than in the lunches as offered. The third graders consumed lunches on average with the percent of energy from saturated fat equal to the lunches as offered.

Third graders consumed less vitamin C and A than the amounts offered in the FPCM lunches. The amounts of vitamins A and C consumed were still larger than the amount recommended of 15mg of vitamin C and 224 RE of vitamin A.

The food categories in order of highest to lowest percent of energy offered that was consumed were: milk at 77% of the milk energy offered was eaten, entree at 67%, bread component at 61%, fruit at 49%, and vegetables at 38%.

Third graders ate less energy and less of every nutrient measured than were available in the lunches they selected.

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APPENDICES

Parent's Informed Consent for Child's Participation in Research Study

Date

I understand that the Department of Nutrition and Food Management at Oregon State University is conducting a study for the Oregon Department of Education, Child Nutrition Division, about the foods third graders eat for lunch. The purpose of this study is to help schools serve lunches which are healthy and well liked by children. My child's class is participating during the week of February 10-14, 1997.

I understand that my child's participation in the study will involve choosing his/her lunch in the cafeteria each day as usual and giving the tray to a researcher who will take it away for about two minutes to record information. Children in the study will sit at a table together and, after lunch, the children will leave their trays on the table instead of throwing away leftovers themselves. I agree not to send lunches from home with my child during the study week.

I understand that my child's participation in the study is voluntary and that she/he may choose not to participate or drop out at any time without penalty. I understand that my child's status with regard to free, reduced, or full priced meals may be disclosed to the researcher. I understand that information will only be reported about the class as a whole rather than for individuals and that data about individual children will be kept strictly confidential with trays identified by number, not be name.

I understand the nature of this research study and agree to let my child participate. I believe my child understands the commitment being made and is participating willingly. My questions have been answered satisfactorily and I know how to contact the researcher should other questions arise.

Please sign and return this letter whether you check Yes or No. Thank you.

____ Yes, I agree to let my child participate ____ No, I do not want my child to participate

_____ _____

Parent's Signature Date

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Appendix B

Child's Informed Consent for Participation in Research Study

Date

I agree to have the foods I choose for school lunches recorded for one week.

I will follow instructions given in class for sitting with my class at lunch and leaving my tray on the table after lunch.

I agree to eat school lunches during the week scheduled, not bring my lunch from home.

I understand that information about what I eat will be kept private. I know that research results will be given only for my whole class and my name will not be used. I understand that I am a volunteer and that I can stop being in the study at any time with no penalty.

I understand what I am being asked to do.

Please sign and return this letter whether you check Yes or No. Thank you.

_____Yes, I agree to participate _____No, I do not want to participate

_____ _____

Child's Signature Date

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Appendix C

Menu for the week of February 10-14, 1997

Reynolds School District

Monday	Tuesday	Wednesday	Thursday	Friday
Tamales	Spaghetti	Nachos	Turkey/Gravy	Ravioli
Pizza	Pizza	Pizza	Pizza	Pizza
Cheeseburger	Cheeseburger	Cheeseburger	Cheeseburger	Cheeseburger
Burrito	Burrito	Burrito	Burrito	Burrito
P.B.Jelly	Turkey	Turkey	Ham/Cheese	Tuna
Sandwich	Sandwich	Sandwich	Sandwich	Sandwich
1% Milk	1% Milk	1% Milk	1% Milk	1% Milk
2% Milk	2% Milk	2% Milk	2% Milk	2% Milk
Carrots	Carrots	Carrots	Carrots	Carrots
Broccoli	Broccoli	Broccoli	Broccoli	Broccoli
Celery	Celery	Celery	Celery	Celery
Cauliflower	Cauliflower	Cauliflower	Cauliflower	Cauliflower
Apples	Apples	Apples	Apples	Apples
Oranges	Oranges	Oranges	Oranges	Oranges
Pears	Salad	Grapes	Fruit Salad	Bananas
Beets	Sunflower sds.	Banana	Banana	Salad
Corn	Mixed Veggies	Beets	Cranberry S.	Pineapple
Saltines	Garlic Bread	Hot Broccoli	Green Beans	Hot Mixed Veg
White Bread	Saltines	Grahams	Hot Rolls	Hot Rolls
Salsa	Wheat bread	Saltines	White Bread	Saltines
Ketchup	Salsa	Salsa	Salsa	Salsa
Mustard	Ketchup	Ketchup	Ketchup	Ketchup
Butter	Mustard	Mustard	Mustard	Mustard
Ranch	Butter	Butter	Butter	Butter
	Applesauce	Wheat Bread	Grahams	Grahams
	Ranch	Ranch	Ranch	Ranch
		Apricots		Grahams
				Cupcake

Appendix D

RECIPE FORM

Entree___Milk___Fruit/Veg___Bread/Grain___Condiment/Spread/Dressing ____

Recipe Name:_____

USDA Modified Recipe:_____ Original Recipe_____ As Purchased Recipe_____

Total Number of Servings the recipe makes (Yield)_____

Serving Size in Volume or Weight_____ (for ounces specif whether volume or weight)

Ingredient Name	Weight Measure *Cooked or raw	Volume Measure *Cooked or raw	Unique Measure i.e. slice, piece, each

SELECTED REYNOLDS S.D.

M		T		W		H		F		NAME		#		F/R		P	

ENTREES	EA	MILK	EA		FRUIT	EA	1 tsp	1 T	¼ c		VEG	EA	1ts	1 T	¼ c	½ c	?
Tamales		1 %			Grapes						Carrots						
PB & Jelly		2 %			Apples						Celery						
Spaghetti		NonFat Choc			Oranges						Broccoli						
Turkey Sand					Pears						Cauliflower						
Sub Sand		BREAD	EA		Banana						Beets						
Nachos		Garlic			Fruit Salad						Corn						
Turkey Gravy		White Bread			Cranberries						Salad Greens						
Ham & Cheese		Wheat Bread			Pineapple						Mixed Veggies						
Ravioli		Saltines									Green Beans						
Tuna Sand		Graham															
Burrito		Rolls			OTHER	EA	1tsp	1 T	¼ c		CONDIMENT	EA	1ts	1 T	¼ c	½ c	
Cheeseburger					Sunflower sds.						Ranch						
Pepperoni					Cupcake						Salsa						
											Ketchup						
											Mustard						
											Butter						

WASTED

A = Ave S= Selected W = Wasted E= Eaten ? =Other Measurement

TROUTDALE

M		T		W		H		F		NAME		#		F/R		P	

ENTR	A	W	E	MILK	A	W	E	FRUIT	A	W	E	VEG	S	W	E
Tamale				1 %				Grapes				Carrots			
PB & Jelly				2 %				Apples				Celery			
Spa ghetti				NF Choc				Oranges				Broccoli			
Turkey Sand								Pears				Cauliflower			
Sub Sand				BREAD	A	W	E	Banana				Beets			
Nachos				Garlic				Fruit Salad				Corn			
Turkey Gravy				White Bread				Cranberries				Salad Greens			
Ham & Cheese				Wheat Bread				Pineapple				Mixed Veggies			
Ravioli				Saltine								Green Bean			
Tuna Sand				Graham											
Burrito				Rolls				OTHER	A	W	E	CONDIMENT	S	W	E
Cheese burger								Sunflower sds.				Ranch			
Pepprni Pizza								Cupcake				Salsa			
												Ketchup			
												Mustard			
												Butter			

ITEM	SIZE	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
cucumbers							
cauliflower							
broccoli							
carrots							
tomato							
sprouts							
green peppers							
olives							
mushrooms							
pickles							
coleslaw							
diced egg							
sunflower seed							