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The Affect of the Placement of Food on the Tray and the Scheduling of Playtime on Plate Waste and Nutrient Intake by Elementary School Children

Elise Walton
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THE AFFECT OF THE PLACEMENT OF FOOD ON THE TRAY AND THE SCHEDULING OF PLAYTIME ON PLATE WASTE AND NUTRIENT INTAKE BY ELEMENTARY SCHOOL CHILDREN

by

Elise Walton

A thesis submitted in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Nutrition and Food Science

Utah State University.
Logan, Utah
1977
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ABSTRACT

The Affect of the Placement of Food on the Tray and the Scheduling of Playtime on Plate Waste and Nutrient Intake by Elementary School Children

by

Elise Walton, Master of Science
Utah State University, 1977

Major Professor: Dr. Bonita Wyse
Department: Nutrition and Food Sciences

For three weeks the plate waste from the students at the Edith Bowen Laboratory School was collected. The students were divided into three units by grade; Unit I, kindergarten and first grade, Unit II, second and third grade; and Unit III, fourth through sixth grade. The total waste of the individual menu items in the three units was weighed to determine the total waste of each food item for the unit. In each unit individual food items from three control trays weighed together, and an average serving portion for the item in each of the three units was obtained.

The study consisted of three phases, each lasting five consecutive school days with one control phase and two experimental phases. During the control phase (Phase 1) the dessert was placed on the front of the tray, in relation to the children and the children played after lunch. The dessert was placed on the back of the tray in relation to the children and playtime was after lunch in Phase 2. In Phase 3, the dessert was placed again on the back of the tray, but playtime was before lunch.
The placement of food on the tray had no measurable affect on the amount of food wasted. When the children played before lunch there was a significant decrease in the amount of food wasted.

The meals as served, consumed, and wasted were analyzed for 22 nutrients, and the nutrient density or Index of Nutritional Quality of the meals was also determined. The meals as served were examined to see if they met the nutrient requirements for a Type A lunch.
Plate waste of well-balanced school lunch meals has become a major issue of public concern (School Foodservice Journal, 1976c). The wastage results in a loss of expended funds and the waste of potential nutrients for the children involved. Serving foods of sufficient quantity and high quality alone does not assure the children of an adequate nutritional intake. The food must be consumed to contribute to the physical and mental development of the children. Dr. Herbert Birch has said, "The nutrition of the individual is the most ubiquitous factor affecting growth, health, and development. It occupies a central position in the multitude of factors affecting the child's development and functional capacity" (Chess and Thomas, 1973).

According to the United States Department of Agriculture (USDA), participation in the National School Lunch Program reached record level during the fiscal year of 1976 (School Foodservice Journal, 1976). The USDA recently conducted a plate waste study in 100 elementary and secondary schools. The results showed that 20 percent of the food in school lunches was wasted.

On-site observations made by school personnel have found that food waste was not entirely due to preference (School Foodservice Journal, 1976b). There were many factors which contribute to the amount of food left on children's plates. These factors were food-related, social or physical. Food-related factors include texture, quality, the aesthetic value of the food, the serving portion and the overuse of certain foods. Social factors which affect plate waste included the anxiousness of the children to go outside and play with their
friends, the availability of the playground equipment, the rapport of
the supervisory teachers with the children, disciplinary actions taken
during the lunch period, parent attitudes and meal patterns at home.
The physical environment and sanitation of the lunchroom played an
important role in determining the amount of food consumed.

Plate waste studies have been used to provide information on food
preferences of children, the overuse of certain food, proper serving
portion, and nutritive intake (Lachance, 1976). To obtain information
on food preference, proper serving size and the overuse of certain foods,
a visual method has been used to measure plate waste. In these studies
the meal was broken down into five separate components and each was
analyzed for its degree of acceptance relative to the others. The
visual method can provide data for foodservice personnel to assist them
in planning not only well-balanced menus, but also those with a higher
degree of acceptance.

To determine the actual nutritive intake of the children, the nutri-
tional value of the food ingested versus the food wasted must be deter-
mined. Plate waste must be weighed on a precise balance and then deduct-
ed from the initial weight of the food served.

The arrangement of food on the tray may affect what children eat.
Lunchroom personnel often arrange the food on the tray and deliver the
tray to the children so that the dessert is in the front of the children
and the main dish is on the far side. One purpose of this study was to
determine the effect of the placement of the food on the tray and how it
affects plate waste. If the children consumed the desserts first, this
may increase their chances of leaving the other meal components. Although
the children may have met their caloric needs, the nutrient value of what
was consumed may not have met their nutritional needs. The second purpose of this study was to investigate the effect of scheduling play time before lunch as a factor to decrease plate waste. Waste cannot be entirely eliminated and a certain amount of plate waste is expected; however, school foodservice personnel need to identify the factors that affect plate waste and devise methods to minimize the waste.

The nutrient density of school lunch menus was also examined. It is of little value to increase consumption of the food that is served if it is of inadequate nutritional quality. Foods of high caloric value and low nutrient density should be used conservatively, because they can be consumed at the expense of foods with a high nutrient density.
Plate waste has always been a major concern for school foodservice personnel, but recently school administrators, legislators and consumers have also been paying attention to this problem. They have realized the importance of decreasing food waste, and reducing the loss of expended funds for wasted food. Schools participating in the National School Lunch Program are required to follow the Type A school lunch pattern, which is designed around the four basic food groups. Using a Type A pattern the four groups provide one-third or more of the Recommended Dietary Allowances (RDA) of nutrients and calories for children of various age groups (Murphy et al., 1969; Head and Weeks, 1973). The Type A lunch pattern is designed to provide approximately one third of the Recommended Dietary Allowances (RDA). To meet this goal, the schools are required to serve: 2 ounces (edible portion as served) of meat or meat alternative; 3/4 cup total of two or more fruits and or vegetables; 1 slice whole grain or enriched bread; 2 teaspoons butter or fortified margarine; and 1/2 pint milk. It is recommended that the lunches include a food high in ascorbic acid each day, a food high in vitamin A, and several foods each day to supply iron. The amounts of food specified in the Type A pattern are based on the RDA for children ages 10 to 12 years. Smaller amounts of the protein rich foods, vegetables and fruits, and butter may be served provided they supply one third the RDA for younger children.

The children's food preferences were not the main criteria when the USDA established the standards for the Type A lunch, however, the acceptance of most foods by the children has been a goal of a majority
of school foodservice personnel. To meet this goal school foodservice supervisors need to know what foods children like and what foods they dislike. Simple research techniques have been developed to enable the supervisor to obtain meaningful information without conducting tests which require a great deal of time and expertise (Lachance, 1976a and Lachance, 1976b). Paul Lachance of Rutgers University has found that the visual technique of measuring plate waste and acceptance testing can provide data to determine what foods are being wasted.

To measure plate waste by the visual method, the testers visually evaluated the amount of waste left on the tray for each menu item in question. Then they marked the estimated amount of waste on the standard forms. The forms were then collected and it was determined which foods were well liked and which were disliked by a significant number of children.

Acceptance testing is a quick and easy method used to determine the overall degree of food preference, and how much this preference varied within the group of children that were being tested. This acceptance method can be used to determine how often a food item can be served before it becomes monotonous to the children, and wasted due to overuse.

Children do the rating and evaluating of the food in acceptance testing. A representative sample of children is selected to participate. Before the children go to lunch they are given a form which has five faces on it with a single word under each face (i.e. great, good, so-so, bad, awful). These five faces describe how the children felt about the food item they were to evaluate. To tabulate the results the faces were assigned numbers from one to five (five is the best score). A food score is obtained by multiplying each rating for the food by the number of children that gave it that rating. The scores are added together and
divided by the number of children that participated to obtain the average food score.

The two methods just described quickly and easily provide the foodservice supervisor with information on overall food preference; however, waste is not entirely due to preference. Many external factors determine how much children consume and how much food is wasted. The food habits of the children in the school lunchroom are a reflection of the food habits in the family (School Foodservice Journal, 1976a). School foodservice personnel cannot be expected to standardize the food habits of the children who come from a variety of homes. The school foodservice supervisor must isolate the factors affecting plate waste which she/he can control. Once these factors have been identified, it is the duty of the supervisor to develop methods or menu changes to combat and minimize the waste.

The scheduling of recess is one of the factors which can be controlled by school foodservice personnel. The scheduling of recess directly after lunch in order to have more time to play (Boysen and Aherns, 1973; Ruppenthal and Hogue, 1977). If there is a limited amount of playground equipment this too adds pressure to eat quickly. Boysen and Aherns (1973) noted that many students left their milk until the very last and then did not have time to finish it. As time ran short some of the children preferred to finish their dessert rather than the milk. The children did not want to remain in the lunchroom longer than necessary and they were not allowed to take food out to the playground.
Ruppenthal and Hogue (1977) found marked changes in plate waste of vegetables, fruit, salad and milk when they switched the recess and lunch period. The children had a larger appetite after playing, because they expended more energy than they did when sitting in a classroom. In this study plate waste was collected and separated into five categories and weighed. Standard servings of each Type A lunch item were weighed for comparison.

Each meal that is served is designed to meet the nutritional goals of the Type A school lunch requirements. It is equally important to assess the extent to which the consumed nutrients meet the nutritional requirements for the students. Head and Weeks (1973) reported inadequate amounts of vitamin A, B₆, B₁₂, thiamin, iron, magnesium and calcium were consumed by the children. Nutrient intake was determined by calculating the nutrient content of the food served and deducting the nutrient content of the wasted food.

For the most part, school lunches provide sufficient quantities of most nutrients. The most common nutrient deficiencies in school lunches are calories, magnesium, iron, calcium, and vitamin A, and B₆ (Murphy et al., 1969; Murphy et al., 1970b; Head and Weeks, 1973). It is of interest to note that all the nutrients that are consumed in inadequate amounts are most often deficient in the food that is served. Thus it is not surprising that nutrients of concern in the typical diet of children in the United States are iron, calcium, vitamin A and C, and thiamin (Patterson, 1971; Lowe et al., 1973). Therefore, little is gained by increasing consumption of the food that is served unless it is of high quality and comes up to the prescribed standards.
The fat content of the school lunch menus has been studied recently because of the concern for plasma cholesterol as a risk factor in coronary artery disease (Schubert, 1973). The USDA recommended that 35 percent of the calories in the school lunch come from fat. The dietary levels of saturated fat, unsaturated fat, and cholesterol have become as important as the level of fat in the diet (Jansen, 1974). Researchers (Head and Weeks, 1973) have found that 43 to 50 percent of the calories in school lunches come from fat. School lunches appear to be reasonably low in cholesterol yet considerable amounts of saturated fats are used in cooking and seasoning of vegetables. The average ratio of polyunsaturated fats to saturated fats was 0.27 (Murphy et al., 1970a). Calorie levels of the menu were closely related to the fat content; therefore, when the fat content of the meal was decreased the nutrient density of the meal was increased.

The concern about plate waste was caused by the loss of money and nutrients. Now that legislators, school administrators and parents are aware of the food wastage problem, research is being conducted to identify the many factors which affect plate waste. The nutrient content of the meals as served must meet the requirements established by the USDA. Therefore, if plate waste is decreased sufficient quantities of nutrients will be available to assure the child of adequate nutritional intake. The nutrient density of the meal should be monitored to assure that the calories from fat are within the recommended levels and within the proportion of calories provided that a similar proportion of nutrients are obtained.
PROCEDURE

Rationale

School food service personnel are aware of the need to study methods to decrease plate waste and increase food consumption. Due to the lack of available data on the factors that affect plate waste, a further investigation was deemed necessary. The purpose of this study was to investigate the influence of the placement of food on the tray and the scheduling of playtime as two potential factors of plate waste.

Participants

This study was conducted at the Edith Bowen Laboratory School, in Logan, Utah. The students were divided into three units by grade; Unit I, kindergarten and first grade; Unit II, second and third grade; and Unit III, fourth through sixth grade. Approximately 190-200 children participated in the school lunch program each day, however 145-160 students actually took part in the study. Preschool children and children from the Exceptional Child Center were counted as part of the number of children who participated in the lunch program. The waste from these children's trays was not collected and used in the study. Those children who brought lunches from home were not counted as part of the study. The children of each unit always sat together for lunch. Those that brought their lunches ate in the lunchroom with the other children in their unit.
Menu selection

Five menus from the Type A school lunch program were selected. The supervisory cook chose these five menus because she felt they were well liked by the children, and that she and the other cooks could successfully prepare these foods on the days they were to be served. The five specially chosen menus that were used throughout the study are printed in Appendix A. The same five menus were used each week to eliminate the food waste due to the varied acceptance of different food.

Food collection

A pilot study was conducted to enable those assisting in the food collection to practice the methods of scraping trays and recording the data. The pilot study also served to desensitize the children to the new method of returning their trays. When we first started to collect the waste on the trays, the children thought we were having a contest to see which unit ate the most food. When the children competed to see who ate the most food they put an unwanted bias into the study. However, by the time we began the actual study, the novelty of the contest had worn off, and the children returned to eating as they always had done.

The study consisted of three phases, one control phase and two experimental phases. Each phase lasted five consecutive school days. During the control phase the lunchroom personnel arranged the food on the tray and handed the tray to the children so that the dessert was on the front of the tray in relation to the child. During the first experimental phase the lunchroom personnel arranged the food
on the tray and then handed the tray to the children so that the
dessert was on the far side of the tray in relation to the child.
For the second experimental phase the children were sent out to
the playground for recess before lunch. The children in each unit
returned and ate together. The food was arranged on the tray and
delivered to the children so that the dessert was on the far side
of the tray in relation to the child.

Each day while each unit was being served, three trays were
taken at random from the serving line. A total of nine trays were
collected each day. As soon as the three control trays for each
unit were collected, each food item was scraped into a separate
preweighed container. The food containers were color coded by
unit for easy identification. The inedible refuse such as orange
peels, was removed before the food was weighed. Portion cups which
were used to serve the catsup and tartar sauce were also removed.
The food in these cups was squeezed out rather than scraped because
the children did not have scrappers to get the last drop out of the
portion cup. Whatever was squeezed out of the portion cups was con­
sidered the edible serving portion. These same procedures were
followed when collecting the waste of these items.

When the children finished eating they took their trays to the
collection table. There one of the assistants took the tray, removed
the paper waste, the silverware and the milk carton, and then passed
the tray on to the next assistant. Four individuals assisted in
scraping the waste from the trays. The waste of each food item was
scraped into a separate preweighed container. These waste containers
were also color coded by unit to match the smaller containers used
to collect the samples of served food. Before the assistants scraped the trays they decided who would scrape each item so that the same person would scrape the same food item off all the trays for all the units. This was done to avoid individual variation in scraping. The wasted milk was poured into a large graduated cylinder and the total waste for each unit was recorded. The trays were stacked at the end of the table and then counted to determine the number of children from each of the three units that participated in the school lunch study that day.

The total waste of the individual item in the three units was kept separate and weighed to determine the total waste of each food item for the unit. The food items from the three control trays were weighed together and an average serving portion for the item in each of the three units was obtained. The cooks at Edith Bowen varied the serving sizes of the protein-rich foods, vegetables, and fruits according to the age of the unit served.

Data processing and nutrient analysis

Recipes were obtained for all foods served during the three phases along with the yield of each recipe. All values were converted to metric units. Each ingredient was assigned its proper food code number from Agriculture Handbook 456. Cooking losses were accounted for by assigning the Handbook food code number for the cooked product. Information was obtained from the labels of foods not prepared in the kitchen. So that the correct food code numbers could be assigned.
The proportion of each ingredient in the average serving size per child for each unit was determined. This same proportion was then assumed to be present in the average amount consumed and wasted per child for each unit. The data was analyzed statistically to determine any differences in waste between the three units and any differences within the unit during the three treatments.

The five meals were analyzed for nutrient content using the Index of Nutritional Quality (INQ) computer program developed at Utah State University. The INQ can be defined for food as:

\[ \text{INQ} = \frac{\text{Percent of nutrient allowance}}{\text{Percent of energy requirement}} \]

The INQ equation reveals the extent to which nutrient allowances are met in proportion to the energy requirement derived from foods. For a diet to be balanced nutrients should be present in the recommended amounts when the energy requirements are met (Wittwer et al., 1977).

The meal as served, the meal as consumed, and the wasted portion of the meal was analyzed for 22 nutrients (Appendix B). The nutrient density or INQ value of the meals was also determined. The meals as served and consumed were examined to see if they provided one-third of the nutrient standards; the goal of the Type A lunch.

The RDA for children 4 to 6 years of age was chosen as the standard for Unit I. For the children in Units II and III the RDA for children 7 to 10 years was used. Reasonable values were assumed when no RDA had been established. These standards were arbitrarily established from the current data bases available at Utah State University and used in the INQ computer program.
RESULTS

Meals as wasted

The data from each unit were analyzed separately so that the waste patterns could be discussed. Definite trends were noted in Units I and III. There was no definite waste pattern established in Unit II.

Unit I showed the most dramatic change in food waste as shown in figure 1. There was a significant drop ($P < .05$) in the amount of food wasted per child in Phase 3 (dessert behind; play first) as compared with Phase I (dessert in front; play after lunch) and Phase 2 (dessert behind; play after lunch). Even though there were significant changes in the total amount of overall food wasted per child, fruit was the only single menu item which showed a significant decrease in Phase 3 versus Phases 1 and 2 (Figures 2 and 3). Milk waste dropped significantly in Phase 3 as compared to Phase 2 (Figure 4). Figures 5 and 6 show the proportion of the menu items that were wasted and how the distribution varied between the phases.

For Unit III, there was significantly more food wasted per child in Phase 2 verses Phases 1 and 3. However, the decrease in waste in Phase 3 was not significant when compared with Phase 1 (Figure 1). The milk wasted in Phase 2 was noticeably ($P < .05$) more than the amount wasted in the other two phases (Figure 4). In Phase 3 significantly more meat was wasted than what was wasted in Phase 2 (Figure 3). Figures 7 and 8 show the composition of the average meal as wasted per child. Except for milk and meat, there were no marked
Figure 1. The average percentage of the meal wasted per child in Unit I (kindergarten and first grade), Unit II (second and third grade), and Unit III (fourth through sixth grade) in each of the three phases (Phase 1 - dessert in front, play after; Phase 2 - dessert behind, play after; Phase 3 - dessert behind, play before).
Unit I

Unit II

Unit III

Phase 1

Phase 2

Phase 3

% of meal wasted
Figure 2. The average percentage of four menu components (vegetables, fruits, bread, desserts) wasted per child. Each bar represents the weekly average for each unit and phase.
Phase 1 Phase 2 Phase 3
Average % of vegetables wasted per child

Phase 1 Phase 2 Phase 3
Average % of fruit wasted per child

Phase 1 Phase 2 Phase 3
Average % of breads wasted per child

Phase 1 Phase 2 Phase 3
Average % of desserts wasted per child

Unit I
Unit II
Unit III
Figure 3. Top - The average percentage of the meal and protein-rich foods that were wasted per child. Each bar represents the weekly average for each unit and phase.

Bottom - The average percentage of protein in the meal wasted per child. Each bar represents the weekly average for each unit and phase.
Average % of meal wasted per child

Phase 1 Phase 2 Phase 3

Average % of protein-rich foods wasted per child

Phase 1 Phase 2 Phase 3

Average % of protein wasted per child

Phase 1 Phase 2 Phase 3

- Unit I
- Unit II
- Unit III
Figure 4. Top - The average percentage of milk wasted per child. Each bar represents the weekly average for each unit and phase.

Bottom - The average percentage of calcium and riboflavin wasted per child. Each bar represents the weekly average for each unit and phase.
Average % of milk wasted per child

Average % of calcium wasted per child

Average % of riboflavin wasted per child
Figure 5. The proportion of each menu item that contributed to the total waste per child. Each circle represents the average weight of the meal as wasted per child in Unit I. The sections represent the percentage by weight from each menu component that contributed to the total waste.
Phase 1

Butter & Sauces

Vegetables 27%

Protein-rich Foods 7%

Fruit 11%

Breads 4%

Milk 46%

Desserts

158.3 grams*

Phase 2

Butter & Sauces

Vegetables 20%

Protein-rich Foods 9%

Fruit 6%

Breads 3%

Desserts

Milk 54%

181.3 grams*

Phase 3

Butter & Sauces

Vegetables 25%

Protein-rich Foods 13%

Fruit 6%

Breads 6%

Desserts 6%

Milk 41%

118.4 grams*

*Total weight of waste per child
Figure 6. The composition of the total meal as served showing the portion of each menu component that was wasted. Each circle represents the total weight of the average meal as served per child in Unit I. The sections represent the percentage by weight of each menu component. The shaded portions of each section show the percentage of the serving that was wasted.
Phase 1
Butter & Sauces

Phase 2
Butter & Sauces

Phase 3
Butter & Sauces

*Total weight of meal as served per child

Unit 1

482.6 grams*

460.7 grams*

468.7 grams*
Figure 7. The proportion of each menu item in the total waste per child. Each circle represents the average weight of the meal as wasted per child in Unit III. The sections represent the percentage by weight from each menu component that contributed to the total waste.
Phase 1

Butter & Sauces 4%
Protein-rich Foods 10%
Milk 38%
Vegetables 33%
Fruit 10%
Breads 3%
Desserts 2%

84.4 grams*

Phase 2

Butter & Sauces 2%
Protein-rich Foods 9%
Milk 43%
Vegetables 27%
Fruit 13%
Breads 4%
Desserts 2%

97.5 grams*

Phase 3

Butter & Sauces 3%
Protein-rich Foods 14%
Milk 27%
Vegetables 40%
Fruit 7%
Breads 5%
Desserts 4%

78.9 grams*

*Total weight of waste per child
Figure 8. The composition of the total meal as served showing the portion of each menu component that was wasted. Each circle represents the total weight of the average meal as served per child in Unit III. The sections represent the percentage by weight of each menu component. The shaded portion of each section shows the percentage of the serving that was wasted.
Phase 1
Butter & Sauces

Phase 2
Butter & Sauces

Phase 3
Butter & Sauces

*Total weight of meal as served per child

Unit III
changes in the amount of individual menu items wasted, yet the proportion changed in each phase.

There were no significant changes in total amount of food wasted by Unit II (Figures 1, 2, and 3). However, the amount of milk wasted in the third phase was less (\( P < .05 \)) than the amount wasted in the second phase (Figure 4). Figures 9 and 10 show the proportion of each single menu item that was wasted and how that proportion changed in each of the three phases.

On the average, the children of Unit I wasted 36 percent of the total meal; Unit II wasted 32 percent; and Unit III wasted 17 percent. Portion sizes varied between the units. Unit I received the smallest portion and Unit III received the largest portions.

**Nutrients wasted**

Significant changes in the waste of major nutrients, i.e., energy, protein, fat, and carbohydrate (Figure 11) were noted for Unit I. The calories and the protein wasted followed the same trend as the total amount of food wasted. The amount of fat and carbohydrate wasted increased significantly in Phase 2 as compared with Phase 3. For all other nutrients, except calcium and riboflavin, no important changes were noted. Calcium and riboflavin were wasted significantly less (\( P < .05 \)) in Phase 3 versus Phase 2 (Figure 4). On an average day of each phase, significantly more calories, protein, fat, carbohydrate, calcium, and riboflavin were wasted in Phase 2 as compared with Phases 1 and 3. The combined waste of these same nutrients on an average day were significantly greater in Phase 1 than in Phase 3.
Figure 9. The proportion of each menu item in the total waste per child. Each circle represents the average weight of the meal as wasted per child in Unit II. The sections represent the percentage by weight from each menu component that contributed to the total waste.
Phase 1
Butter & Sauces

Phase 2
Butter & Sauces

Phase 3
Butter & Sauces

*Total weight of waste per child

Unit II
Figure 10. The composition of the total meal as served showing the portion of each menu component that was wasted. Each circle represents the total weight of the average meal as served per child in Unit II. The sections represent the percentage by weight of each menu component. The shaded portion of each section shows the percentage of the serving that was wasted.
Phase 1
Butter & Sauces

Phase 2
Butter & Sauces

Phase 3
Butter & Sauces

*Total weight of waste per child

Unit II

501.1 grams*

485.5 grams*

489.5 grams*
Figure 11. The average percentage of major nutrients (i.e. energy, fat, carbohydrate, and protein) wasted per child. Each bar represents the weekly average for each unit and phase.
Average % of energy wasted per child

Average % of fat wasted per child

Average % of carbohydrate wasted per child

Average % of protein wasted per child

Unit I
Unit II
Unit III
Fat, calcium, and riboflavin were the only nutrients that showed significant changes in the amounts wasted in Unit III. The amount of fat wasted per child in Phase 3 were significantly less than the amount wasted in Phase 2. However, on an average day significantly more calories, protein, fat, carbohydrate, calcium and riboflavin combined were wasted in Phase 2 as compared with Phases 1 and 3.

For Unit II, calcium and riboflavin were the only two nutrients that were wasted significantly more \( P < .1 \) in Phase 2 than Phase 3. The combined waste of calories, protein, fat, carbohydrate, calcium, and riboflavin on an average day of Phase 2 was greater \( P < .05 \) than the combined waste of these same nutrients on an average day of Phase 3. On an average day of Phase 1 the combined waste of these nutrients was significantly greater than an average day of Phase 3.

**Nutritional adequacy of the meals as served**

The goal of one-third of the nutrient standards was met or exceeded by most of the nutrients in the meals of the school lunch. Of those nutrients which fell short of the one-third mark, all but linoleic acid, cholesterol, and carbohydrate were in sufficient amount to meet one-fourth of the nutrient standards. Recommended Dietary Allowances have not been established for these three nutrients and the standards that were used may have been too high. Tables 1, 2 and 3 show how the lunches at the Edith Bowen School provide nutrients which are of concern in the typical diet of children in the United States. Figures 12 to 12 show the average meal as served to Unit I and III and how the nutrient content of those meals met the goal of
Table 1. Nutrients of concern in the typical diet of children of the United States were selected to show how these nutrients as served in the average meal were consumed by the child in Unit I. The amounts of the nutrients as served and consumed were compared with one-third and one-fourth of the Recommended Dietary Allowances for children 4 to 6 years of age.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Served</th>
<th>Consumed</th>
<th>1/3 RDA</th>
<th>1/4 RDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy (Kcal/meal)</td>
<td>Calcium (mg/meal)</td>
<td>Iron (mg/meal)</td>
<td>Vit A (I.U./meal)</td>
</tr>
<tr>
<td>Served</td>
<td>$577 \pm 138^*$</td>
<td>$390 \pm 108$</td>
<td>$2.7 \pm 0.5$</td>
<td>$1000 \pm 664$</td>
</tr>
<tr>
<td>Consumed</td>
<td>$355 \pm 166$</td>
<td>$234 \pm 122$</td>
<td>$1.6 \pm 0.7$</td>
<td>$545 \pm 267$</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>$600$</td>
<td>$267$</td>
<td>$3.3$</td>
<td>$833$</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>$450$</td>
<td>$200$</td>
<td>$2.5$</td>
<td>$625$</td>
</tr>
<tr>
<td>Phase II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>$560 \pm 76$</td>
<td>$433 \pm 25$</td>
<td>$2.5 \pm 0.6$</td>
<td>$1006 \pm 687$</td>
</tr>
<tr>
<td>Consumed</td>
<td>$376 \pm 70$</td>
<td>$271 \pm 22$</td>
<td>$1.6 \pm 0.5$</td>
<td>$541 \pm 333$</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>$600$</td>
<td>$267$</td>
<td>$3.3$</td>
<td>$833$</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>$450$</td>
<td>$200$</td>
<td>$2.5$</td>
<td>$625$</td>
</tr>
<tr>
<td>Phase III</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>$567 \pm 111$</td>
<td>$445 \pm 39$</td>
<td>$2.6 \pm 0.6$</td>
<td>$990 \pm 506$</td>
</tr>
<tr>
<td>Consumed</td>
<td>$415 \pm 78$</td>
<td>$319 \pm 23$</td>
<td>$1.8 \pm 0.5$</td>
<td>$573 \pm 173$</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>$600$</td>
<td>$267$</td>
<td>$3.3$</td>
<td>$833$</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>$450$</td>
<td>$200$</td>
<td>$2.5$</td>
<td>$625$</td>
</tr>
</tbody>
</table>

*Standard deviation
Table 2. Nutrients of concern in the typical diet of children of the United States were selected to show how these nutrients as served in the average meal were consumed by the child in Unit II. The amounts of the nutrients as served and consumed were compared with one-third and one-fourth of the Recommended Dietary Allowances for children 7 to 10 years of age.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Energy (Kcal/meal)</th>
<th>Calcium (mg/meal)</th>
<th>Iron (mg/meal)</th>
<th>Vit A (I.U./meal)</th>
<th>Thiamin (mg/meal)</th>
<th>B6 (mg/meal)</th>
<th>B12 (mg/meal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>603 ± 133*</td>
<td>399 ± 94</td>
<td>2.9 ± 0.6</td>
<td>946 ± 474</td>
<td>0.3 ± 0.1</td>
<td>0.3 ± 0.1</td>
<td>1.1 ± 0.5</td>
</tr>
<tr>
<td>Consumed</td>
<td>411 ± 187</td>
<td>258 ± 127</td>
<td>1.9 ± 0.7</td>
<td>537 ± 148</td>
<td>0.2 ± 0.1</td>
<td>0.2 ± 0.1</td>
<td>0.8 ± 0.3</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>800</td>
<td>267</td>
<td>3.3</td>
<td>1100</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>600</td>
<td>200</td>
<td>2.5</td>
<td>825</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Phase II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>602 ± 92</td>
<td>455 ± 37</td>
<td>2.8 ± 0.6</td>
<td>1096 ± 681</td>
<td>0.3 ± 0.1</td>
<td>0.3 ± 0.1</td>
<td>1.3 ± 0.2</td>
</tr>
<tr>
<td>Consumed</td>
<td>442 ± 90</td>
<td>335 ± 62</td>
<td>2.1 ± 0.8</td>
<td>499 ± 66</td>
<td>0.2 ± 0.1</td>
<td>0.2 ± 0.1</td>
<td>0.8 ± 0.1</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>800</td>
<td>267</td>
<td>3.3</td>
<td>1100</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>600</td>
<td>200</td>
<td>2.5</td>
<td>825</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Phase III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>588 ± 105</td>
<td>458 ± 57</td>
<td>2.7 ± 0.5</td>
<td>1030 ± 433</td>
<td>0.3 ± 0.04</td>
<td>0.3 ± 0.04</td>
<td>1.3 ± 0.2</td>
</tr>
<tr>
<td>Consumed</td>
<td>454 ± 67</td>
<td>353 ± 44</td>
<td>2.0 ± 0.4</td>
<td>570 ± 48</td>
<td>0.2 ± 0.03</td>
<td>0.2 ± 0.1</td>
<td>1.0 ± 0.1</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>800</td>
<td>267</td>
<td>3.3</td>
<td>1100</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>600</td>
<td>200</td>
<td>2.5</td>
<td>825</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*Standard deviation
Table 3. Nutrients of concern in the typical diet of children of the United States were selected to show how these nutrients as served in the average meal were consumed by the child in Unit III. The amounts of the nutrients as served and consumed were compared with one-third and one-fourth of the Recommended Dietary Allowances for children 7 to 10 years of age.
<table>
<thead>
<tr>
<th></th>
<th>Energy (Kcal/meal)</th>
<th>Calcium (mg/meal)</th>
<th>Iron (mg/meal)</th>
<th>Vit A (I.U./meal)</th>
<th>Thiamin (mg/meal)</th>
<th>B6 (mg/meal)</th>
<th>B12 (mg/meal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>$649 \pm 136^*$</td>
<td>$417 \pm 90$</td>
<td>$3.2 \pm 0.6$</td>
<td>$1226 \pm 913$</td>
<td>$0.3 \pm 0.1$</td>
<td>$0.3 \pm 0.1$</td>
<td>$1.1 \pm 0.5$</td>
</tr>
<tr>
<td>Consumed</td>
<td>$621 \pm 143$</td>
<td>$378 \pm 67$</td>
<td>$2.5 \pm 0.6$</td>
<td>$939 \pm 350$</td>
<td>$0.3 \pm 0.1$</td>
<td>$0.2 \pm 0.1$</td>
<td>$0.9 \pm 0.4$</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>800</td>
<td>267</td>
<td>3.3</td>
<td>1100</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>600</td>
<td>200</td>
<td>2.5</td>
<td>825</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Phase II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>$638 \pm 94$</td>
<td>$457 \pm 38$</td>
<td>$3.3 \pm 1$</td>
<td>$1138 \pm 748$</td>
<td>$0.3 \pm 0.1$</td>
<td>$0.3 \pm 0.1$</td>
<td>$2.0 \pm 1.7$</td>
</tr>
<tr>
<td>Consumed</td>
<td>$537 \pm 88$</td>
<td>$375 \pm 32$</td>
<td>$2.7 \pm 1$</td>
<td>$717 \pm 238$</td>
<td>$0.3 \pm 0.1$</td>
<td>$0.2 \pm 0.1$</td>
<td>$1.1 \pm 0.2$</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>800</td>
<td>267</td>
<td>3.3</td>
<td>1100</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>600</td>
<td>200</td>
<td>2.5</td>
<td>825</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Phase III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Served</td>
<td>$606 \pm 93$</td>
<td>$468 \pm 69$</td>
<td>$3.0 \pm 0.4$</td>
<td>$1212 \pm 662$</td>
<td>$0.3 \pm 0.4$</td>
<td>$0.3 \pm 0.1$</td>
<td>$1.4 \pm 0.2$</td>
</tr>
<tr>
<td>Consumed</td>
<td>$511 \pm 88$</td>
<td>$408 \pm 58$</td>
<td>$2.3 \pm 0.5$</td>
<td>$795 \pm 195$</td>
<td>$0.3 \pm 0.4$</td>
<td>$0.2 \pm 0.1$</td>
<td>$1.2 \pm 0.1$</td>
</tr>
<tr>
<td>1/3 RDA</td>
<td>800</td>
<td>267</td>
<td>3.3</td>
<td>1100</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>1/4 RDA</td>
<td>600</td>
<td>200</td>
<td>2.5</td>
<td>825</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*Standard deviation
Figure 12. The nutrient content of the average meal as served to Unit I during Phase 1. Each bar represents the percent of the nutrient standard (RDA for 4-6 year olds) contained in the meal as served.
Energy
Protein
Calcium
Iron
Vitamin A
Thiamin
Riboflavin
Niacin
Vitamin C
Pant. Acid
Vit. B₆
Vit. B₁₂
Fat
Sat. Fat
UNS. Oleic
UNS. Linol
Choleste
Carbo tot
Fiber
Phosphorus
Sodium
Potassium

--- INQ baseline of the consumed portion of the meal
----- One-fourth the RDA
......... Goal of nutrient content for Type A Lunch (One-third the RDA)

Average amount consumed
Average wasted portion of meal
Figure 13. The nutrient content of the average meal as served to Unit I during Phase 2. Each bar represents the percent of the nutrient standard (RDA for 4-6 year olds) contained in the meal as served.
Figure 14. The nutrient content of the average meal as served to Unit I during Phase 3. Each bar represents the percent of the nutrient standard (RDA for 4-6 year olds) contained in the meal as served.
Nutrient Standard

- INQ baseline of the consumed portion of the meal
- One-fourth the RDA
- Goal of nutrient content for Type A Lunch (one-third the RDA)

Average amount consumed
Average wasted portion of meal
Figure 15. The nutrient content of the average meal as served to Unit III during Phase 2. Each bar represents the percent of the nutrient standard (7-10 year olds) contained in the meal as served.
Figure 16. The nutrient content of the average meal as served to Unit III during Phase 3. Each bar represents the percent of the nutrient standard (7-10 year olds) contained in the meal as served.
Type A lunches. These five meals were selected because significant differences were noted in the total amount consumed per child.

Table 4 shows a distribution of INQ values of the 22 nutrients in the meals as served to Unit I. This distribution is representative of the other units. Unsaturated linoleic acid and cholesterol were served in quantities lower than the standards. However, the arbitrary cholesterol standard of 600 milligrams may have been too high and therefore a low INQ for cholesterol might be more desirable. Of the remaining 20 nutrients; slightly less than half were supplied in fair to adequate amounts in proportion to the calories derived from the meal. The rest of the nutrients were in proper proportion with an INQ value greater than 1.00.

Nutritional adequacy of the meals as consumed

Most of the nutrients which were evaluated were consumed in amounts insufficient to provide one-fourth the nutrient standards (figures 9 to 13). The INQ of the nutrients which were consumed was high. All of the nutrients with the exception of a few nutrients (primarily linoleic acid and cholesterol), had an INQ value of 0.75 or better. Approximately one-half of the nutrients had an INQ value greater than 1.00; the desired level. Figures 12 to 16 show the INQ of the portion of the meal consumed.

Fat content of the meals

Fat contributed 38 to 43 percent of the calories in the meals as served. Saturated fat constituted 37 to 43 percent of the total fat content of the meal. The polysaturated to saturated fat ratio
Table 4. Distribution of INQ (Nutrient-Density ratio) values of the 22 nutrients analyzed in the meals as served to Unit I.

<table>
<thead>
<tr>
<th></th>
<th>INQ 0.75</th>
<th>0.75 INQ 1.00</th>
<th>INQ 1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>UNS. Linol Cholesterol</td>
<td>Iron</td>
<td>Protein</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thiamin</td>
<td>Calcium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamin C</td>
<td>Vitamin A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pant. Acid</td>
<td>Thiamin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamin B6</td>
<td>Riboflavin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbo-tot</td>
<td>Vitamin B12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fiber</td>
<td>Fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sodium</td>
<td>Sat. Fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Potassium</td>
<td>UNS. Oleic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Phase 2</td>
<td>UNS. Linol Cholesterol</td>
<td>Iron</td>
<td>Protein</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Niacin</td>
<td>Calcium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pant. Acid</td>
<td>Vitamin A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamin B6</td>
<td>Thiamin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamin B12</td>
<td>Riboflavin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbo-tot</td>
<td>Vitamin C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fiber</td>
<td>Fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sodium</td>
<td>Sat. Fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Potassium</td>
<td>UNS. Oleic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Phase 3</td>
<td>UNS. Linol Cholesterol</td>
<td>Iron</td>
<td>Protein</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamin C</td>
<td>Calcium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pant. Acid</td>
<td>Vitamin A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamin B6</td>
<td>Thiamin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbo-tot</td>
<td>Riboflavin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fiber</td>
<td>Niacin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sodium</td>
<td>Vitamin B12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Potassium</td>
<td>Fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sat. Fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>UNS. Oleic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Phosphorus</td>
</tr>
</tbody>
</table>
ranged from 0.20 to 0.31. The cholesterol content of the meals were relatively low, ranging from 75 to 93 milligrams.
DISCUSSION

The data were analyzed by units because there were significant differences in the amount of food wasted per child between units. The weather appeared to be an important factor in the amount of food wasted. During Phase I it was snowy and cold outside. The weather during Phase 2 was beautiful. The first spring-like weather of the year was a welcome break from the cold, bleak winter. During the third phase it rained every day, but the children still went outside to play even though it was cold and muddy. It is thought that the good weather probably caused an increase in the amount of food wastage in the second phase, because the children were anxious to go outside and play in the sunshine and warmer temperatures. As a result, they were less interested in their food.

The trends in Units I and III were possibly a reflection of the weather and behavioral characteristics common to the children of these age groups. The changes in Unit II were probably due to weather only. These children were in a transitional phase in which many different behavior patterns were being displayed. In this unit the children are young, yet they are beginning to follow the behavior patterns of the older children. Therefore, the two extreme behaviors cancelled out the effects of one another, and no definite trends were noted.

The difference in the trends of waste between Unit I and III could have been a reflection of the differences in behavioral development. The span from 6 to 12 years of age is quite broad in terms of childhood and personality development (Mussen et al., 1973). There
are important differences between ages 5 to 9 and 9 to 12.

The children of both units were subject to the same food and weather yet the different patterns were probably caused by the way they reacted to the conditions of the environment.

Researchers (Hoffman and Hoffman, 1964) in the field of child development have noted that boys exhibited an earlier and clearer awareness of the sex-typed behavior appropriate for their sex in comparison to girls. As early as three years of age boys have become aware of some of the activities and objects that are masculine, while the girls showed more variability up to age 10. Five year old boys identified with their father, yet girls of the same age identified with both parents. Seven year old boys are expected to be brave and independent. Seven year old girls can be afraid and brave; fighters and non-fighters. The tomboy traits of little girls were less subject to punishment than feminine behavior in little boys. Therefore, there was a less clear-cut adoption of the traditional female behavior in girls. When children entered school they came into direct contact with their peers and culture's definition of sex roles. Children are gradually forced to accommodate and fit into the male and female roles established by the cultural mores which they are subject to. As they become older they become more socially oriented and true personality development began between the ages of 9 to 12.

It is thought that it was primarily the girls of each unit which could have caused the different trends in food wastage particular to that unit. Unlike the boys who were unaffected by the weather, the girls of Unit III did not want to get wet and muddy. At that age
(9 to 12) they had begun to acquire a more feminine role and were more interested in personal adornment. The girls of Unit I (ages 5 to 6) had not yet acquired feminine roles and they still showed a strong preference for masculine games and activities no matter what the weather was like. This in part explains why there was a significant decrease in food waste in Phase 3 as compared with Phase 1 and 2 in Unit I; and why the amount of food wasted in Phase 3 by Unit III was slightly less than, but not significant from the amount wasted in Phase 1. The girls of Unit I went outside, played hard and expended more energy even though it was wet and muddy. The girls of Unit III tended to congregate in the halls of the school building rather than go outside and play in the cold and muddy school yard. Thus when it came time to come in and eat, the girls and boys of Unit I had expended more energy than if they had sat in a classroom before eating, as in Phases 1 and 2. They were not only more hungry, but also more ready to settle down and eat. In Unit III it was mostly the boys who had participated in vigorous outdoor activities, while many of the girls chose to remain inside. The girls of Unit II caught in the middle of the continuum, probably displayed both types of behavior which cancelled one another out and therefore no definite trends were seen in Unit II.

The placement of food on the tray had no affect on food consumption. The drop in waste in Phase 3 was due to the scheduling of the play period before lunch, and the increase of waste in Phase 2 was very likely due to the good weather coupled with the desire of the children to get out and play. Few children turned their trays and and some of those who had turned their tray, turned it back to the
proper position when asked by staff or told by their peers. The children ate the food in which they were most interested before anything else. It did not matter where it was placed on the tray; it was simply there in front of them and therefore easily accessible.

Overall, there were significant changes in the total amount of food wasted per child, yet milk and to a small extent fruit were the only items which showed significant changes in the amount of food wasted. The increase ($P < .05$) in the amount of milk wasted in Phase 2 along with the small amount of dessert wasted substantiates observations made in a previous study (Boysen and Aherns, 1972).

More vegetables were wasted than any other food item, especially in the third phase. This illustrates that no matter how hungry children are they will not eat vegetables, or other less desirable foods. It is questionable if the decrease waste of vegetables noted in another study (Ruppenthal and Hogue, 1977) was significant.

The waste of milk and fruit dropped in Phase 3 because the children's appetite not only increased after playing, but also they were more thirsty. These two foods satisfied their thirst. Protein-rich foods were wasted more in the third phase by the third unit because these foods were hot. The boys came in hot and sweaty from vigorous outdoor activity, and probably found the hot foods less appealing than the cold foods such as milk and fruit.

In a recent plate waste study (Ruppenthal and Hogue, 1977) the changes in plate waste were expressed on a percent basis, but the investigators did not state if the changes were significant. The results of this study showed that the significant variations in the total meal wasted was due to variations in waste of all the menu items.
No one menu item, with the exception of milk and fruit showed a difference, rather all the food items together made that difference. When the children ate more, they ate more of everything; and when they wasted more, they wasted more of everything.

Few significant differences in the waste of single nutrients were noted, with the exception of calcium and riboflavin, because there were not significant differences in the amount of any single menu item wasted except milk. Therefore, the waste patterns of calcium and riboflavin—the major nutrients of milk—closely followed the waste pattern of milk. People eat to satisfy hunger and their psychological appetite and craving; not to satisfy nutrient requirements. Common sense tells us that when consumption of nutrient-rich foods is increased, that the nutrient intake is automatically increased. The increased consumption usually does not markedly \((P < 0.05)\) increase consumption of any particular nutrient, but rather an increase in several nutrients is noted. For all units, few significant changes in single nutrients (calories, protein, fat, carbohydrate, calcium, and riboflavin) were noted; yet when they were grouped together and compared significant differences were evident. Significant changes were not noted for other groups of nutrients that were analyzed in this study.

**Nutritional adequacy of the meals as served**

School lunches which do not meet the nutritional goal of one-third the RDA for several nutrients should not automatically be classified as "poor" lunches \((\text{Head et al., 1973}; \text{Murphy et al., 1970b}; \text{Murphy et al., 1969})\). The RDA include margins of safety for all nutrients except calories \((\text{Murphy et al., 1969})\). School lunches which
provide one-fourth the RDA of several nutrients are probably adequate because of the safety factors written into the RDA. Young children have snacks throughout the day which will also add to the total nutrient intake for the day, provided these snacks are nutrient dense snacks and not empty calorie snacks.

The vitamin A content of the meals as served at the Edith Bowen School met the Type A goal, unlike others (Murphy et al., 1969) who found that 20 percent of the school studied provided less than one-fourth of the total daily allowance for Vitamin A. The thiamin content of the meals as served fluctuated between one-fourth to one-third of the allowance as compared with others who found the thiamin content completely inadequate in other school lunches. The older children at Edith Bowen received only one-fourth of their niacin and B6 allowance. The nutrient analysis did not take into account the niacin equivalents contributed from tryptophan. The protein content of the meal exceeded the requirement, thus adequate tryptophan was available to fill in the niacin deficit. The B6 content of the meals met one-fourth of the total daily allowance. However, the B6 data available at this time is limited and therefore, no definite conclusions can be drawn. The caloric content of the meal met the Type A requirement for the younger children, but for the older ones it provided only one-fourth of their total RDA. The iron content of the meals met the Type A goal for the older children but it provided only one-fourth of the total RDA for the younger children. The standard for iron was the same for both age groups, but the older children received larger serving portions. School lunches have been shown to fall short of the one-third requirement for iron (Head et al., 1973).
Unsaturated linoleic acid, cholesterol, and carbohydrate were the only nutrients which consistently fell short of the one-fourth mark for the standards established arbitrarily. It is possible that the arbitrary standards set for these nutrients may be too high.

**Nutritional adequacy of the meals as consumed**

The nutrients of the meals as served which did not meet the Type A goal were consumed in amounts less than or equal to the one-fourth goal. However, this did not mean that nutrients that met or exceeded the goal were consumed in adequate amounts.

Caloric consumption ranged from 20 to 25 percent of the RDA yet the meals themselves were low in calories (25 to 31 percent of the RDA). This is not a cause for concern because most children obtain calories from snacks. Calcium consumption always provided at least one-fourth of the RDA. The consumption of ascorbic acid varied from less than one-fourth to greater than one-third of the total daily allowance. The consumption of thiamin, iron, and B6 consistently fell slightly below one-fourth of the total daily allowance. The amount of Vitamin A consumed provided 22 to 26 percent of the RDA. The consumption of B12 met or exceeded the one-third goal. Results from other studies (Head and Weeks, 1975) have shown that Vitamin A, thiamin, B6, B12, and iron were consumed in amounts less than one-third the RDA. Yet these are often the nutrients that are served in quantities less than the one-third goal.

The majority of the nutrients consumed did not satisfy one-fourth to one-third of the nutrient standards, but they all had an INQ value of .75 or greater, with the exception of linoleic acid,
cholesterol, carbohydrate, and fiber. Although the food consumed was of high nutrient quality. The nutrient quality of the meal consumed can be more important than the quantity of the meal consumed, provided what is consumed has a high nutrient density. Children can not be expected to eat all of the lunch, but they can consume a meal of good nutritional quality provided a meal of high nutritional quality is served.

Fat content of the meal

The fat content (38 to 43 percent of the calories), the low polyunsaturated to saturated fat ratio (0.20 to 0.31), and the low cholesterol level (75 to 93 milligrams per serving) of the meals as served at Edith Bowen was the same as that found in other studies of school lunches (Head and Weeks, 1975; Head et al., 1973; Murphy et al., 1970a). The high saturated fat content of the meals is unlikely to change as long as the schools receive butter as a commodity item from the government. More polyunsaturated fats need to be used to increase the ratio and to provide more linoleic acid in the meals. Baked desserts, which are rich in fat constitute the majority of desserts served at Edith Bowen and other schools. Unlike another study (Murphy et al., 1970a) which showed that fat provided 40 percent of the calories in the meals as served, and over 50 percent of the calories consumed; no difference was noted between the percent of the calories from fat in both the calories served and consumed. In light of the controversy concerning levels of cholesterol in the diet and the occurrence of coronary heart disease, the low cholesterol levels of school lunches should probably remain unchanged.
CONCLUSIONS AND RECOMMENDATIONS

School boards must not only be aware of the factors which affect plate waste, but also be able to identify those factors which they can and cannot control. School administrators cannot control the weather, but they can control the scheduling of playtime. This can directly affect the appetite of the children. When the weather is good, the children are anxious to go outside and play. Thus, playing outside became more important than eating, and as a result more food was wasted. Instead of allowing the consumption of the meals to be subject to the weather, why not let these two factors work together to complement one another.

There are many benefits which result from the increased consumption of food. At age 6 most children enter a phase of rapid growth. They increase their height 5 to 6 percent per year, and their weight 10 percent per year (Watson, 1954). Children are proportioned like an adult, yet the growth occurs in the lengthening of the limbs and the increase in muscle tissue (Mussen et al, 1963). Thus, just an increase in milk consumption is important, because the calcium and protein contained in the milk is so necessary for the health, growth, and development of bone and muscle mass. (Goodhart and Shils, 1976; Robinson, 1972).

There is a need for guidelines to be established for Type A lunches, which would recommend portion size and the nutrient standards for the various age groups. One portion size and one set of nutrient standards (Murphy et al, 1969) is not sufficient for children of different ages. If all the children in this study had been served the
same amount of food to satisfy the Type A requirement, substantially more food would have been wasted. The RDA were established to provide objectives and goals which aid in planning practical diets and adequate nutrition for healthy people (NAS/NCR, 1974). Therefore, to utilize the RDA to its fullest capacity, age differences must be taken into account. Recommended daily allowances are written for many age groups because of the different nutritional requirements of each age group. The USDA has just recently written five new sets of portion sizes based on the recommended daily allowances specific to each age group. The five groups consist of group 1, ages 1 to 2; group 2, ages 3 to 5; group 3, ages 6 to 8; group 4, ages 9 to 11; and group 5, ages 12 on up. These new portion sizes went into effect October 1, 1977 and are on probation until February; at which time they will be evaluated. If these new standards prove to be satisfactory, they will become the new regulations for the Type A school lunch in September 1978.

In this study, two RDA standards (Appendix B) were used because they reflected the different nutritional needs of the students. The amount of food served to Unit I was nutritionally adequate when compared with the standard specific to that age group. Yet if the same amount of food had been compared to the standard for the older children, the amount of food served would have been inadequate. This would not have given a true picture of what was being served and consumed relative to the real nutritional needs of the younger children.

The scheduling of playtime does have an affect on the amount of food wasted. One recommendation for future study would be to divide each unit or grade in half so that half of the children of the same age group would be out playing while the other half ate their lunch.
Food preferences, weather, and children's behavioral characteristics could be controlled better by dividing the groups play and lunch times. Each day when the amount of food and nutrients wasted were compared for the three phases, the differences in waste was more significant on a daily rather than a weekly basis. The trend is there and it could be more evident in a study of longer duration. It takes a long time for people to establish eating habits and it takes a long time for researchers to determine those patterns and habits.

The placement of the food on the tray made no difference in the density of the food consumed, because the whole meal was right in front of the children. In the homes of most children the dessert is not placed on the table at the beginning of the meal. The dessert in the school lunch program is served with the main course as a matter of convenience for the cooks. The dessert is not a requirement of a Type A lunch. The ideal situation might be to leave the dessert off the tray when the meal is served to the children. Then if the children desired to return for the dessert they could do so. It would be difficult and impractical for most school cafeterias to have the children return for their dessert. Fruits and desserts of high nutrient densities should be served more often to insure that the meal as served and consumed would have a high nutrient density. These desserts would also help decrease the total fat and saturated fat content of the meal.

Plate waste cannot be eliminated, but it can be controlled. Since a certain amount of waste is to be expected, the school lunch supervisors must make sure that the meals that they serve contain nutrient dense foods so that the children get a high proportion of nutrients to calories in the food that they consume.
LITERATURE CITED


APPENDIX A

Type A School Lunch Menus

1
Batter-Fri Fish Fillet
Orange Slice
Tartar Sauce
Sunshine Potatoes
Buttered Peas
Pineapple Sweet Roll
Milk

2
Hot Dog in Bun
French Fries
Catsup
Spiced Applesauce
Ginger Cookie
Milk

3
Meat Loaf with
Creole Sauce
Buttered Corn
Tossed Salad
Sesame Seed Rolls
Butter
Reese Chocolate
Candy Bars
Milk

4
Roast Beef
Mashed Potatoes
with Brown Gravy
Buttered Green Beans
Parkerhouse Roll
Butter
Orange Wedge
Milk

5
Sliced Turkey
in Bun
Buttered Mixed
Vegetables
Raw Turnip Circle
Peanut Butter Cookie
Milk
### APPENDIX B

**Nutrient Standards**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Unit I</th>
<th>Unit II and III</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Energy</em></td>
<td>1800 kcal</td>
<td>2400 kcal</td>
</tr>
<tr>
<td><em>Protein</em></td>
<td>30 g</td>
<td>36 g</td>
</tr>
<tr>
<td><em>Calcium</em></td>
<td>800 mg</td>
<td>800 mg</td>
</tr>
<tr>
<td><em>Iron</em></td>
<td>10 mg</td>
<td>10 mg</td>
</tr>
<tr>
<td><em>Vitamin A</em></td>
<td>2500 IU</td>
<td>3300 IU</td>
</tr>
<tr>
<td><em>Thiamin</em></td>
<td>0.9 mg</td>
<td>1.2 mg</td>
</tr>
<tr>
<td><em>Riboflavin</em></td>
<td>1.1 mg</td>
<td>1.2 mg</td>
</tr>
<tr>
<td><em>Niacin</em></td>
<td>12 mg</td>
<td>16 mg</td>
</tr>
<tr>
<td><em>Vitamin C</em></td>
<td>40 mg</td>
<td>40 mg</td>
</tr>
<tr>
<td><em>Pantothenic Acid</em></td>
<td>5 mg</td>
<td>5 mg</td>
</tr>
<tr>
<td><em>Vitamin B6</em></td>
<td>0.9 mg</td>
<td>1.2 mg</td>
</tr>
<tr>
<td><em>Vitamin B12</em></td>
<td>1.5 mcg</td>
<td>2.0 mcg</td>
</tr>
<tr>
<td>+Fat</td>
<td>76 g</td>
<td>101.3 g</td>
</tr>
<tr>
<td>+Saturated Fat</td>
<td>22.8 g</td>
<td>30.4 g</td>
</tr>
<tr>
<td>+Unsaturated Oleic</td>
<td>30.4 g</td>
<td>40.5 g</td>
</tr>
<tr>
<td>+Unsaturated Linoleic</td>
<td>22.8 g</td>
<td>30.4 g</td>
</tr>
<tr>
<td>+Cholesterol</td>
<td>450 mg</td>
<td>600 mg</td>
</tr>
<tr>
<td>+Carbohydrate total</td>
<td>252 g</td>
<td>336 g</td>
</tr>
<tr>
<td>+Fiber</td>
<td>3 g</td>
<td>3 g</td>
</tr>
<tr>
<td><em>Phosphorus</em></td>
<td>800 mg</td>
<td>800 mg</td>
</tr>
<tr>
<td>+Sodium</td>
<td>3000 mg</td>
<td>4000 mg</td>
</tr>
<tr>
<td>+Potassium</td>
<td>3000 mg</td>
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</tr>
</tbody>
</table>

*Recommended Dietary Allowances established by the National Academy of Sciences.

+Nutrient Standards arbitrarily established at Utah State University