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# Management Aspects of School Lunch Programs In Iowa

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## SUMMARY

A survey was made of management aspects of lunch programs in 25 Iowa schools (6 high, 6 elementary and 13 with 12 grades) that were drawn as a sample to represent the 622 Iowa schools in which full meals were served during the 1948-49 school year. Two kinds of information were obtained in this survey: information about procedure used in studying school lunch programs and information about aspects of management in school lunch programs.

### PROCEDURE

Analyses of covariance were used to test for significant differences among three groups of schools.

Aside from variation attributed to differences in the number of lunches served and capacity of lunch rooms—

1. There were no significant differences among three groups of schools in:
  - a. dining room area
  - b. annual total food cost of operating lunch programs.
2. There were significant differences in:
  - a. total labor time scheduled for school lunch personnel
  - b. school lunch kitchen area
  - c. dining table area
  - d. annual labor cost of operating school lunch programs
  - e. annual "other" costs of operating school lunch programs
  - f. annual total cost of operating school lunch programs.

Estimates of sample size desirable for further studies of aspects of management in school lunch programs in Iowa—assuming the number of schools to be sampled remained the same—ranged from 8 (for a study of kitchen area among elementary schools) to 115 (for a study of labor time among schools with 12 grades).

### ASPECTS OF MANAGEMENT IN SCHOOL LUNCH PROGRAMS

Daily average number of revenue lunches served during the year was 197 (range, 89-513). Six percent of Type A lunches served to pupils were free; average price charged pupils in 22 Iowa schools was 22.6 cents (range, 16-30 cents); 18 schools charged either 20 or 25 cents.

Percentage participation of pupils in the school lunch program on the day observed averaged 34 percent, with a range of 10 percent in a city high school with enrollment of 1,175, to 96 percent in two schools with 12 grades with enrollments of 124 and 135.

Pupils returned an average of 0.9 ounce of food. Salads, vegetables and main dishes were returned in largest amounts; fruit juices, not at all.

In none of the schools did standard portions of the foods served supply the amounts of all nine nutrients that Type A lunches should supply (i.e., one-third of the daily allowances recommended by the National Research Council for children 10 to 12 years of age). Food energy and iron were

the nutrients which were inadequate in the largest percentage of lunches.

Average number of full-time workers employed in school lunch programs was 2.5 (range, 1-5); 18 schools employed two or three full-time workers. The number of part-time workers (adult and student) ranged from none to 28.

Average number of revenue lunches served was: 7.9 per hour of labor time (range, 2.6-11.1); 7.2 per minute per serving line at peak load of service (range, 5-12).

There was wide variation among schools in the proportion of total labor time devoted to:

Preparation	(average, 32%; range, 17-56%)
Service	(average, 22%; range, 10-34%)
Cleaning	(average, 35%; range, 20-47%)
Other work	(average, 3%; range, 0-10%)
Other activities	(average, 8%; range, 1-20%)

This variation may have reflected differences in: number of lunches served, training and experience of workers, organization of work, special responsibilities of workers, space, equipment and layout of unit, work habits of individuals, number and type of food items served, and amount of time contributed by persons not connected with the program.

Square feet of kitchen space per average daily number of revenue lunches averaged 2.3 (range, 0.6-8.5) and met the recommended 1.5 square feet in 19 schools. Square feet of dining room space per seat ranged from 0 to 15 and met the recommended 9 square feet in 9 schools.

Length of the basic food route averaged 57.5 feet (range, 24.0-121.8 ft.); within food preparation area it averaged 33.9 feet (range, 14.8-64.5 ft.).

More than half of the schools studied had institution-type refrigerators and ranges; fewer than half had good facilities for washing dishes. Elementary schools in towns of less than 50,000 and schools with 12 grades had less institution-type equipment than high and elementary schools in large cities. Differences in equipment were reflected in the division of labor time and in the menu served.

Total income from all sources during the school year divided by number of revenue lunches served, averaged 27 cents in all schools (range, 16-47 cents). Chief source of income in all schools was the sale of lunches, which averaged 21 cents (range, 9-36 cents). Federal reimbursement averaged 4 cents (range, 0-7 cents); milk, banquets, ice cream and candy averaged 2 cents (range, 0-10 cents); and other sources, 1 cent (range, 0-5 cents).

Total cost averaged 26 cents per revenue meal (range, 16-48 cents), and was divided as follows:

Food costs,	15 cents (range, 7-25 cents)
Labor costs,	8 cents (range, 4-19 cents)
Other costs,	3 cents (range, less than 1-12 cents)

In general, the school lunches that most nearly met recommendations for nutritional adequacy appeared to be those in which either the per meal cost, preparation time or total amount of energy or protein supplied by the lunch were higher than the average for all schools.



# Management Aspects of School Lunch Programs in Iowa<sup>1</sup>

BY BEATRICE DONALDSON AND GRACE M. AUGUSTINE<sup>2</sup>

Efficient management of school lunch programs involves the operation of the food service to provide attractive, palatable and nutritionally adequate meals and the realization of the educational potentialities of such programs. These are recognized as important management aspects of feeding children at school.

## WHAT THIS BULLETIN REPORTS

This bulletin reports results of a survey of management aspects of school lunch programs in 25 Iowa schools which were drawn as a sample to represent the 622 Iowa schools in which full meals were served during the 1948-49 school year. The survey was made in connection with a regional study of the nutritional status of school children and the influence of the school lunch upon it.

Two kinds of information were obtained in this survey: 1) information about methodology used in studying school lunch programs and 2) information about aspects of management in school lunch programs.

## PROCEDURE

The methods used in selecting a sample of schools to be studied and in collecting and analyzing data are described.

Formulas employed in estimating the desirable sample size for further studies of specified aspects of school lunch programs in Iowa are given; estimates arrived at by means of the formulas are reported.

The use of analyses of covariance in testing null hypotheses relating to the existence of significant differences among three groups of schools is described, and the results of the tests are summarized.

<sup>1</sup> Contribution No. 9, Subproject II, "The Nutritional Status of School Children: The School Lunch as an Influencing Factor" of the North Central Region Cooperative Project NC-5, "Nutritional Status and Dietary Needs of Population Groups": Iowa Agricultural Experiment Station, Ames, Iowa, Project 1021.

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## ASPECTS OF MANAGEMENT IN SCHOOL LUNCH PROGRAMS

A primary function of management in school lunch programs is to provide nutritionally adequate, attractive and palatable meals at low cost through the use of available workers, materials and equipment. Information about the extent to which programs in Iowa schools functioned successfully and about management practices that contributed to this success was obtained in the survey and is reported here.

In addition to providing a basic description of the operation of Iowa school lunch programs, this bulletin includes a summary of the findings reported in 20 other surveys and relates these findings to the present data. Certain studies summarized here were devoted to a single aspect of management. Thus, plate waste was studied by Boren (5) and Lynn (16) in one school; and by Jenkins (12) and Wilson (33) in several schools. The nutritional adequacy of lunches served in 12 schools was analyzed by Stenborn (22), while Meyer and others (17) and Velat and others (28) were primarily concerned with problems of methodology encountered in such nutritional evaluations.

Other studies dealt with several aspects of management. Those of James (11), Kitchin (14), Laughlin (15) and Moulton (18) made intensive use of material from one school. Others like those of Dreisbach and Handy (7), Emmons (9), Habig (10), Kennedy (13), Rogers (20), Wayne (30) and Western Washington Dietetic Association (32) used data from a number of schools; numbers vary from Kennedy's 3 to Habig's 164.

Basic materials on planning and equipping school lunchrooms were developed by the Production and Marketing Administration (25) and the Bureau of Human Nutrition and Home Economics, USDA (23). Bryan (6) and West and Wood (31), in texts on school cafeterias and food service in institutions, have developed principles of organization and management that are useful in evaluating school lunch programs. Statistics related to the operation of school lunch programs in the United States and a summary of the National School Lunch Program were issued by the Production and Marketing Administration (26, 27).

Material from all of these sources contributed to the interpretation and evaluation of information obtained about school lunch programs in Iowa, reported in this bulletin.



## POTENTIAL USEFULNESS OF BULLETIN

Persons with a specialized interest in research will find in this bulletin suggestions concerning the collecting and interpreting of school lunch data and suggestions for future studies.

The many persons concerned with improving the nutritional status of children will find here information about the contributions that school lunch programs may be expected to make to this cause.

Administrators can compare the school lunch programs for which they are responsible with programs in Iowa and throughout the country, as well as with standards proposed by authorities in this field. They may also find practical suggestions for improving their programs.

## HOW THE STUDY WAS MADE

Pilot studies were conducted in two Iowa schools during the school year, 1947-48. Procedures were developed, and the scope of management research for the Iowa school lunch project was determined.

In the state-wide study of management, 25 schools were selected from the 622 in which full meals were served during the 1948-49 school year. In addition to type, schools were classified according to location: cities of 50,000 or more population, towns and cities of less than 50,000, and rural areas.<sup>3</sup> The sample for the groups was:

1. 6 junior and senior high schools
2. 6 elementary schools
3. 13 schools having 12 grades in one unit.

## COLLECTION OF DATA

The schedule used in recording the data was developed by the Bureau of Human Nutrition and Home Economics, United States Department of Agriculture and used with its permission.

Data were collected during the period from October 1948 through May 1949. On the first day at each school, the investigator conferred with the administrator and school lunch manager, observed the operation and obtained background information. On the next day she collected specific data on the management and operation of the lunch program.<sup>4</sup>

## ANALYSIS OF DATA

The hypotheses tested were that, other than variation attributed to the number of lunches served and capacity of the lunchroom, there are no differences among three groups of schools (junior and senior high, elementary, and schools having grades 1 through 12) in:

<sup>3</sup> See Appendix, fig. A-1.

<sup>4</sup> Some kinds of information were not obtained from all of the 25 schools in the sample for the following reasons:

- a. A "Type A lunch," as defined for the National School Lunch Program, was served in only 23 schools.
- b. Data about the actual serving of lunch are reported for 24 schools serving full meals and for 22 serving Type A lunches.
- c. Data based on annual financial records are reported for 22 schools serving full meals and 20 serving Type A lunches.

1. Total labor time scheduled for school lunch personnel
  2. School lunch kitchen area
  3. Dining room area
  4. Dining table area
  5. Food cost
  6. Labor cost
  7. Other cost
  8. Total cost
- of operating school lunch programs during the school year, 1948-49.

The hypotheses were tested by analyses of covariance in which the Y variable was one of the eight characteristics and the X variable was:

- For 1 and 2: average daily number of revenue lunches served
- For 3 and 4: number of seats in dining room
- For 5 through 8: total number of revenue lunches served during the school year, 1948-49.

The F test was applied to determine significance of adjusted means.

To estimate sample size for each of the three types of schools, variances were calculated for: per lunch labor time scheduled, per lunch kitchen area, per seat dining room and table area, and per lunch food, labor, other and total costs. Values obtained can be used in the formula for estimating sample size for management studies in Iowa:

$$n = \frac{n_o}{1 + \frac{n_o}{N}}, \text{ in which } n_o = \frac{t^2 s^2}{d^2};$$

t = 2; s<sup>2</sup> = variance; d = one-half the 95-percent confidence interval; N = schools in population.<sup>5</sup>

To present an extensive picture of the management of school lunch programs in Iowa, data were summarized in terms of mean values, ranges and distributions for each type and all schools in the sample.

## FINDINGS

The findings of this survey of 25 Iowa school lunch programs are of two kinds: 1) results of tests of hypotheses concerning relationships between types of schools and specified aspects of the programs, and estimates of sample size desirable for such a study; 2) information about aspects of management in Iowa school lunch programs which indicated specific needs for efficient management and operation.

## STATISTICAL ANALYSES

Analyses of covariance show that, other than variation associated with the X variable, there were no significant differences among the three groups of schools in (1) dining room area and (2) annual food cost. There were significant differences, other than variation associated with the X variables, among the three groups in the other six characteristics studied. The values of F are shown in table 1.

<sup>5</sup> W. G. Cochran. Sample survey techniques. North Carolina State College, Raleigh, N. C. (Mimeo.) Series No. 7. 1948. p. 13.



TABLE 1. VALUES OF F OBTAINED IN ANALYSES OF COVARIANCE OF EIGHT VARIABLES IN THREE GROUPS OF SCHOOLS.

Y Variable	F value
Total daily labor time scheduled for school lunch personnel .....	17.83**
School lunch kitchen area .....	11.10**
Dining room area .....	1.58
Dining table area .....	8.72**
Annual food cost .....	1.47
Annual labor cost .....	4.74*
Annual other cost .....	10.82**
Annual total cost .....	7.81**

\* Significant; probability between 5 and 1 percent.  
 \*\* Highly significant; probability less than 1 percent.

Estimates of sample size, for use in further management studies in Iowa, based on 622 school lunch programs, range from 8 (for a study of kitchen area among elementary schools) to 115 (for a study of labor time among schools with 12 grades). (See Appendix, table A-3.) In 1950, Emmons (9) and Rogers (20) used the same formula with the current value for N and determined the size of sample for their studies to be 83 schools.

#### ASPECTS OF MANAGEMENT IN SCHOOL LUNCH PROGRAMS

There are several purposes to be achieved in the management of school lunch programs and a variety of resources to be organized for realizing these purposes. Management includes the activities involved in achieving the objectives of the school lunch program through the effective use of available resources. A primary purpose is the provision of nutritionally adequate, attractive and palatable lunches to school children at low cost. Or one may say that a purpose of school lunch programs is:

1. To make as high as possible
  - a. The nutritional adequacy of the food served (at least one-third of the child's daily dietary allowances)
  - b. The actual consumption of the served portion
  - c. The pupil participation in the program
2. To make as low as possible the cost of lunches to pupils.

For efficient operation, managers need to know the aims of the program and how they are inter-related. For example, an increase in the nutritive value of the lunch may increase costs and decrease participation. The more clearly managers recognize the alternatives and the more information they have about factors affecting the program, the greater the potentialities are for efficient operation and management.

This section summarizes information obtained about the success with which these interdependent purposes of school lunch programs were achieved in Iowa schools. In addition comparisons are made with similar data reported in other studies.

#### PUPIL PARTICIPATION

According to the report of the U. S. Production and Marketing Administration (26) there were

1,009 Iowa schools that took part in the National School Lunch Program in 1950; 142,817 pupils participated. Data about the numbers served in the 25 schools are shown in table 2. In 14 schools the number of revenue lunches served on the day observed was approximately the same as the daily average for the school year; in eight, it was considerably lower and in three, appreciably higher.

In 22 schools serving Type A lunches, an average of 34 percent of the pupils participated on the day observed. For individual schools, participation ranged from 10 to 96 percent. Comparable studies in Indiana (10), Iowa (9) and Ohio (13) found average participation of 71 percent. In 62 Ohio schools (30) and in 39 schools throughout the United States (7) average participation was 52 and 63 percent, respectively. Ranges of participation reported were 20-100 and 21-100 percent (9, 7).

From the information obtained in this study, no conclusions can be made as to why average participation was low in Iowa schools. Additional studies are needed to learn why pupils do or do not eat the school lunch in order to make suggestions for increasing participation.

#### COST OF SCHOOL LUNCHES TO PUPILS

Prices charged pupils in Iowa schools were comparable to prices throughout the country. In 1949 the typical price charged children for a complete meal served in schools receiving federal reimbursement was 20 cents, and the average price of school lunches of all types was 25 cents (27). Eighteen of the 22 Iowa schools that served Type A lunches charged pupils 20 or 25 cents; the average price was 22.6 cents.

Of the 3,055 Type A lunches served in the 22 schools on the day observed, 4 percent were free. During the year 1948-49, in 20 Iowa schools 6 percent were free whereas in all schools in the United States receiving federal reimbursement, 15 percent of the Type A meals were free (27).

When classified according to price charged pupils, in general, participation was higher in schools charging under 25 cents. In Emmons' (9) study, participation was 54 percent in 19 schools where lunches sold for 25 to 30 cents, and 64 percent

TABLE 2. MEAN NUMBER AND RANGE OF LUNCHES SERVED IN IOWA SCHOOLS.

Period covered	Type of lunch	No. of schools reporting	No. of lunches served	
			Mean	Range
The day observed	Total lunches*	24	194	85-515
The day observed	Pupil lunches	24	176	69-481
The day observed	Revenue lunches†	25‡	187	68-505
School year: daily average§	Revenue lunches	25	197	89-513

\*Included lunches served to all pupils and adults, including workers.

†Included all lunches served to customers, including free lunches but excluding lunches served to workers (adult and student).

‡Daily average figures for April were used for school to which it was impossible to return on second day.

§Total number of revenue lunches served during the school year, divided by number of days on which school lunch was served.



TABLE 3. ENROLLMENT AND PERCENT PARTICIPATION IN 22 IOWA PROGRAMS CLASSIFIED BY PRICE OF LUNCHESES AND TYPE OF SCHOOL.

Price of lunch	Type of school	No. schools	Average total no. pupils enrolled	Percent pupil participation	
				Mean	Range
\$0.30	High school	2	1,039	14	10-20
0.25	High school	2	736	14	13-16
0.25	Elementary school	4	597	25	18-54
0.25	School with 12 grades	4	203	65	50-96
0.20	Elementary school	1	649	31	
0.20	School with 12 grades	7	246	73	52-88
0.18	Elementary school	1	360	21	
0.16	School with 12 grades	1	135	96	

TABLE 4. AVERAGE PERCENT OF RECOMMENDED DIETARY ALLOWANCES FOR SCHOOL CHILDREN PROVIDED BY 24 IOWA SCHOOLS ON DAY OBSERVED.

Nutrient	24 schools allowances for children 10-12 yr.		6 high allowances for children 10-12 13-15		6 elementary allowances for children 10-12 7-9		12 grades 1-12 allowances for children 10-12
Calories	31	36	28	27	34	30	30
Protein	37	41	34	33	38	37	37
Calcium	37	38	33	34	40	38	38
Iron	32	38	30	28	34	32	32
Vitamin A	47	32	29	47	60	54	54
Thiamine	36	43	35	32	38	35	35
Riboflavin	38	41	36	37	44	38	38
Niacin	39	39	31	32	39	42	42
Ascorbic acid	57	49	41	53	67	64	64

cent in 64 schools where prices were 20 to 25 cents. Participation was higher in elementary than in high schools and highest in schools having 12 grades, as shown in table 3. The Iowa data agreed with Habig's (10) findings that the size of the school seemed to influence participation.

#### NUTRITIONAL ADEQUACY OF SCHOOL LUNCHESES

The Type A lunch was designed to provide at least one-third of the daily allowances recommended by the National Research Council for children 10 to 12 years of age (19). As defined by the National School Lunch Program, it includes (24):

1. One-half pint of whole milk as a beverage
2. Two ounces of lean meat, poultry, fish or cheese or the equivalent in other protein-rich foods
3. Three-fourths cup of vegetables or fruit or both
4. One or more portions of bread or muffins, or other hot bread made of whole-grain or enriched flour or cereal
5. Two teaspoons of butter or fortified margarine.

It was recognized, however, that dietary needs

of older and younger pupils differed from those of children 10 to 12 years. To evaluate the nutritional adequacy of the lunches served, the percentages of recommended dietary allowances provided by the lunches were calculated for each of nine nutrients as shown in table 4. The 24 school lunches on the whole provided an average of more than one-third of the allowances recommended for 10-12 year old children, falling slightly below the standard only in calories and iron. The average nutritive values of lunches served in a group of schools, however, may conceal important information about the ways in which individual schools meet nutritional standards.

The number of lunches which provided at least one-third of the daily allowances of each of nine nutrients recommended for children 10-12 years old and the number which provided less are shown in table 5. No lunch supplied one-third of the daily allowances of all nine nutrients. In three lunches, only calories were deficient; in two, only vitamin A; in one, niacin, and in another, ascorbic acid. Five lunches were deficient in six or more nutrients; all of these were deficient in calories, protein and iron, and all but one, in calcium. Since nutritive values were calculated on the basis of a standard portion of each food item served, the adequacy of lunches actually consumed may have been greater because of second portions or less because of plate waste.

Studies of lunches reported by other investigators indicated that nutritional adequacy varied widely. Dreisbach and Handy (7) found that riboflavin was adequate in all 39 lunches studied; protein was inadequate in 28 and calories in 13. James (11) found that ascorbic acid was high in all lunches because of the citrus fruit juice available as a donated commodity, and vitamin A was inadequate more frequently than other nutrients. Stenborn (22) found that in every lunch served on 5 consecutive days riboflavin and vitamin A were above the recommended amounts and calories and ascorbic acid below. Velat and others (28) found that in lunches served in a Maryland school only vitamin A, calcium and ascorbic acid met or exceeded one-third of the allowances for 10-12 year old children.

Results from this and other studies indicate that those responsible for planning school lunch menus need to be more aware of the recommended dietary allowances for children of various ages. To provide minimum amounts of nutrients sug-

TABLE 5. NUMBER OF LUNCHESES IN 24 IOWA SCHOOLS FOR WHICH SPECIFIED PERCENTAGES OF RECOMMENDED ALLOWANCES FOR CHILDREN 10-12 YEARS OF AGE WERE PROVIDED.

Nutrients	33.3 percent or more			Less than 33.3 percent		
	Total	50% or more	33.3-49.9%	Total	25.0-33.2%	Less than 25%
Ascorbic acid	21	14	7	3	1	2
Riboflavin	20	1	19	4	4	0
Protein	17	0	17	7	7	0
Vitamin A value	14	11	3	10	4	6
Niacin	14	6	8	10	7	3
Calcium	14	2	12	10	9	1
Thiamine	14	2	12	10	8	2
Iron	11	0	11	13	9	4
Calories	5	0	5	19	14	5



gested, it is important to follow carefully the menu pattern presented in the National School Lunch Program.

#### ACCEPTABILITY OF SCHOOL LUNCHES

Nutritional benefits of lunch programs to school groups depend on number of pupils participating, adequacy of lunches and acceptability of food served. When weighed amounts of each food item returned were compared with amounts served, percentages differed as shown in table 6. Percentages of served food returned were lower than Boren's (5) average of 7 percent. As in the present study, other workers also found that salads and vegetables were returned in largest amounts (7, 12, 15, 16).

The average and range of ounces of food returned per pupil were: 0.9 and 0.1-3.3 for total schools, 0.3 and 0.1-1.4 for high, 1.4 and 0.3-2.0 for elementary and 1.2 and 0.2-3.3 for schools including 12 grades. Other reports of average plate waste showed a range of 0.6 to 2.5 ounces (7, 13, 14, 33). The amount of food returned per person in 24 Iowa schools exceeded  $\frac{1}{2}$  ounce for only seven menu items and was within 1 ounce for these items; less than  $\frac{1}{2}$  ounce was reported by Augustine and others (3).

Many factors are related to acceptability of school lunches. This study was not designed to measure their influence. The data, however, together with conclusions from other studies suggest that a high level of acceptability is likely to be associated with:

1. Advising and assisting pupils during the lunch period.
2. Serving foods that have attractive appearance, good flavor and texture. (Vegetables well-seasoned and not overcooked and raw vegetables and salads crisp and cold were received better than vegetables lacking these characteristics.)
3. Serving familiar and popular foods. (Pupils in one high school returned a high percentage of a fruit ball of dried fruit and honey the first time it was served.)
4. Avoiding too frequent repetition of a food. (Nearly one-third of the cheese served in a school with 12 grades was returned, apparently because cheese had been served very frequently.)
5. Offering a choice among food items of comparable nutritive value.
6. Arranging food attractively on serving plates.
7. Serving food in forms easily managed. (Elementary students are likely to return noodles or finely chopped vegetables.)

tary students are likely to return noodles or finely chopped vegetables.)

8. Serving reasonably small portions to younger pupils and limiting their amount of bread and sandwiches.

#### MANAGEMENT OF RESOURCES IN SCHOOL LUNCH PROGRAMS

This section about the aspect of management concerned with the efficient organization and use of available resources presents information from the 25 Iowa schools that were covered in this survey and from others. The resources discussed are: personnel, facilities, equipment, finances and food supplies.

It is the responsibility of management to decide how much of what kinds of resources to use and then to use them or supervise their use so that they will produce the largest possible amount of the desired results. Efficiency in the use of resources may be reflected in any one of these results. For instance, reorganizing work schedules or a better layout of equipment may make lunch preparation possible in fewer minutes of labor time. A result of this improved organization may decrease the hours of the labor force or the number of employees. Either change may result in a lower price to the pupils, and this, in turn, may encourage more students to participate in the lunch program. Thus there would be increased achievement in terms of two desired ends. Similarly, if food prices decline, this lower cost may be reflected either in lower lunch prices or in more nutritious and attractive lunches at the same price, or in some combination of these alternatives.

#### PERSONNEL

The majority of school lunch workers in the three high and three elementary schools in cities of over 50,000 population were women with 5 or more years experience in commercial, hospital or school kitchens. These lunch programs were supervised by persons responsible for management of programs in city school systems. On the other hand, cook-managers were responsible for management of programs in nine schools having 12 grades. Most of these employees were homemakers over 50 years old with no previous experience in quantity food service.

The average number of full-time workers in 24 schools was two and one-half with a range of one to five; there were two employed in 11 schools, and three in seven schools. Bryan (6), on the basis of reports from 62 schools, suggested as a representative ratio, one full-time employee for 55 students served. Since 22 schools had part-time workers, the ratio for the 24 schools of one full-time employee for 70 pupils is not comparable. Students worked part-time in 15 schools; the number ranged from one to 28, and the median was five. There were part-time regular workers in eight schools and volunteer workers in five.

TABLE 6. PERCENT OF SERVED FOOD RETURNED IN 24 IOWA SCHOOLS ON THE DAY OBSERVED.

Type of food	24 schools	6 high	6 elementary	12 grades 1-12
Salads	10	10	2	10
Vegetables	9	2	12	11
Main dishes	8	1	10	11
Breads & sandwiches	5	1	12	5
Desserts	4	4	8	2
Milk	3	1	4	3
Fruits	2	11		2
Fruit juice	*	*	*	*
Total food	5	2	6	5

\*Less than 1.



PRODUCTIVITY OF LABOR IN PREPARING AND SERVING SCHOOL LUNCHESES

It is generally recognized that productivity of labor, represented by the number of minutes of labor time used per lunch served, is related to the total number of lunches served. Analysis of covariance indicated that when daily labor time scheduled for lunch personnel in 25 schools was adjusted to a common mean number of average daily lunches served, differences among the three groups of schools were highly significant.

The average number and range of minutes of labor time per revenue lunch for the total schools, high, elementary and schools with 12 grades were: 7.5 and 5.4-23.1, 8.4 and 5.7-23.1, 7.0 and 5.4-13.4, and 7.2 and 5.4-11.3, respectively. When the productivity of labor was figured according to the number of revenue lunches served per hour of labor time, the average and range were: 7.9 and 2.6-11.1, 7.2 and 2.6-10.6, 8.0 and 4.5-10.5, and 8.3 and 5.3-11.1, respectively.

The average number of minutes of labor time per lunch served was 6.7 for 12 schools that served 150 lunches or more and 9.9 for 12 that served fewer. Moreover, in the eight schools in which recorded labor time per lunch was less than 7 minutes, 150 or more lunches were served. In a similar study Dreisbach and Handy (7) found an average of 6.5 minutes of labor time used per lunch served; these figures were based on total number of lunches served and would thus be lower than for this study. Others reported labor time as 8.5 minutes (6, 18).

In four schools all students were served lunch at the same time; in the others, lunches were served over a period of 1 hour or longer. Thus the best measure of the productivity of labor in serving lunches is the average number of revenue lunches served per minute per serving line at the peak load of service. This average for the 24 schools was 7.2 and the range was 5-12; in 20 schools, the range was from 6 to 8. Dreisbach and Handy (7) reported a range of 5-16 for 17 schools. Bryan (6) stated that it was possible to serve plate lunches including a beverage and dessert to 12-15 pupils per minute.

DIVISION OF LABOR TIME

Management is concerned not only with the amount of labor used in school lunch programs, but also with the division of labor time. During work schedule other activities were carried on such as waiting, eating lunch, drinking coffee and resting. There was wide variation among the 24

schools in the division of labor time on the day observed. The average percentage distribution of total labor time is shown in table 7. Equal time is suggested for preparation, service and cleaning (6, 32).

ORGANIZATION OF WORK

Managers of school lunch programs who wish to use the available labor force as effectively as possible should recognize the influence of many factors upon the amount and distribution of labor time in school lunch programs. In addition to number of lunches served, and training, experience and time schedules for workers, other factors such as organization of work, special responsibilities of workers, space, equipment and layout of the unit, work habits of individuals, number and type of food items served and the contributed time of persons all have some influence. These factors are so interrelated that it is difficult to measure the effect of any one of them in the data about labor time. It is, however, possible to indicate the kind of effect certain of them may have.

There were marked differences among the schools in the way in which the work connected with school lunch programs was organized. In the three high and three elementary schools, supervised by directors of lunch programs in city school systems, work was organized and scheduled daily and, in general, employees worked a specified number of hours. Special cleaning duties and preparation for the following day were scheduled after lunch. In contrast, work schedules were not planned ahead in most of the schools having 12 grades when cook-managers were responsible for the management. Workers were permitted to leave when the routine duties for the day were completed. These employees seemed to have difficulty in arranging work so that food was prepared on time; they seemed to work more strenuously than cooks in larger schools.

In some schools, home economics teachers helped plan menus or superintendents' staffs helped with financial reports and purchasing, and the amount of "other work" done by the workers was correspondingly less.

Cleaning duties accounted for a larger percentage of total labor time than either preparation or service in five high, five elementary and four schools with 12 grades. Most of the other schools had no institution-type equipment except ranges and sinks. The variation was considerable also in the amount and kind of cleaning lunch personnel did, though in all schools they were responsible for kitchen equipment.

Productivity of labor can indicate efficiency of the organization and utilization of some of the resources of lunch programs. The average number of minutes per meal may be used as a guide for planning schedules for new programs or for analyzing labor time in an existing program. If the labor time is high, the manager may need to find out whether employees need more training, if

TABLE 7. PERCENTAGE DISTRIBUTION OF TOTAL LABOR TIME.

Schools	Work activities				Other activities
	Preparation	Service	Cleaning	Other	
6 high	25	28	36	4	7
6 elementary	29	19	37	4	11
12 with 12 grades	40	20	32	1	7
24 total schools	32	22	35	3	8



schedules need reorganizing or if some duties of lunch workers should be assigned to other personnel.

#### SPACE ALLOWANCES

Some of the variation in the productivity and the division of labor in the Iowa schools was related to variation in the amount of space available for the operation of the lunch program.

Sixteen schools provided kitchens expressly for preparing and serving school lunches.<sup>6</sup> In nine, the lunch was prepared in the home economics laboratory, and work had to be scheduled when classes were not using the laboratory. In some cases this arrangement resulted in relatively strenuous and inefficient work for the school lunch personnel.

#### KITCHEN AREA

The total number of square feet of kitchen space divided by the average number of revenue lunches served daily during the school year is a measure for determining adequacy of kitchen areas. Where laboratories were used, only space actually used for preparation, dishwashing and service was included in the calculations. Analysis of covariance showed that, when the kitchen area provided in the 25 Iowa schools was adjusted to a common mean number of average daily revenue lunches served, differences among the three groups of schools were highly significant.

The average square feet and range of kitchen space per average daily number of revenue lunches for total schools, high, elementary and schools with 12 grades were: 2.3 and 0.6-8.5, 3.3 and 2.1-8.5, 1.5 and 0.6-3.1 and 2.0 and 0.9-4.8, respectively. In 164 schools, Habig (10) found that the median for the average number of square feet of kitchen space per lunch served was 2.5. Dreisbach and Handy (7) reported the range of space to be from 0.6 to 4.1 square feet.

Bryan (6) suggested that 1.5 to 2 square feet per person served was adequate kitchen space for most schools. In six high, three elementary and 10 schools with 12 grades, the space was 1.5 square feet or more per average daily number of revenue lunches served. Eight of the nine laboratories provided at least 1.5 and six, at least 2.0. The use of these laboratories was reflected in schedules of work; in some the space greatly exceeded the suggested standard, and space was not arranged for efficient production.

#### DINING ROOM AND DINING TABLE AREAS

Of the 25 Iowa schools, 17 had dining rooms; four used converted gymnasium balconies and corridors; three used gymnasiums, and one, classrooms and library. The seating capacity accommodated the total number of students in only four schools; in 21, students ate in shifts.

Analysis of covariance indicated that when the

<sup>6</sup> Information on space and equipment was obtained for the 25 schools.

amount of dining room space provided in 25 Iowa schools was adjusted to a common mean number of seats in the dining room, differences among the three groups of schools were not significant. The wide variation among schools within each group in the amount of dining room space makes average values mean little. The range in number of square feet of space per seat for each was: 0-11.1 for 6 high, 7.8-15.4 for 6 elementary and 5.0-12.7 for 13 schools with 12 grades. Nine square feet of dining room space for each person seated at one time has been suggested as a minimum for school lunch rooms (25, 31). This standard was met or exceeded by: 2 high, 3 elementary and 4 schools having 12 grades.

Analysis of covariance showed that when the amount of table space provided in 25 Iowa schools was adjusted to a common mean number of seats in the dining room, differences among the three groups of schools were highly significant. In general, high schools provided the most space, 2.2 square feet, and elementary schools the least, 1.6, while space for schools with 12 grades averaged 1.8; the range for all schools was 0-2.5 square feet. No corresponding data were reported in other studies.

#### LENGTH OF BASIC FOOD ROUTE

Adequate space is essential for efficiency in the preparation and service of meals. It is desirable, however, to arrange principal work areas and pieces of equipment so that distances traveled in the normal course of preparing and serving lunch are direct and relatively short. In several larger high schools, storage areas were located in basements or in other areas some distance from the kitchens. In the smaller schools of all three groups, the storage area was more often a part of the kitchen or connected to it. The length of the basic food route within the food preparation area, excluding the distance from the storage area to preparation sink, was determined, as well as length of the complete route (23). These are shown in table 8. Other studies have found average food routes to be 56, 58 and 66 feet (7, 23). When the basic food route within the preparation area is direct with no cross or reverse traffic, it can be kept relatively short even when preparation and serving areas are relatively large.

Some indication of the relationship between per meal labor time and the amount of space available is shown in table 9. A partial explanation for the higher average per meal labor time in the high schools may be that the average space allowances

TABLE 8. LENGTH OF FOOD ROUTE IN FEET IN 25 IOWA SCHOOL LUNCH KITCHENS.

Schools	Total basic route		Preparation area route	
	Average	Range	Average	Range
6 high	86.8	54.3-121.8	46.4	24.5-64.5
6 elementary	51.1	24.0- 88.8	36.0	18.0-59.0
13 with 12 grades	46.9	28.0- 68.7	27.2	14.8-49.0
25 total schools	57.5	24.0-121.8	33.9	14.8-64.5



TABLE 9. AVERAGE PER MEAL LABOR TIME, KITCHEN AREA AND LENGTH OF BASIC FOOD ROUTE FOR 24 IOWA SCHOOL LUNCH KITCHENS.

Schools	Per meal labor time (min.)	Per meal kitchen area (sq. ft.)	Length of basic food route (ft.)
6 high	8.4	3.3	86.9
6 elementary	7.0	1.5	51.1
12 with 12 grades	7.2	2.0	47.0
24 schools	7.5	2.3	57.6

and distances traveled in preparation and service were greatest for these schools.

Adequate kitchen and dining space is important for efficient production and service of school lunches. Although adequate kitchen space was provided in most schools, there was some evidence of need for improvement in arrangement of space for more effective use of employees' time. Possibilities for improving food habits, social behavior and citizenship of the pupils were limited because of inadequate dining space. Schools need to recognize the possibility of achieving desired educational objectives of the lunch program through better organization and management of resources concerned with facilities.

#### EQUIPMENT

In some Iowa schools, managers organized their work schedules without the use of equipment considered desirable in preparing and serving meals in quantity; in others, appropriate and adequate amounts and kinds were purchased with funds available. Personnel were expected to make the most efficient use of the equipment. The number of schools, classified by group, having certain equipment items are shown in table 10.

Family-size ranges were used in eight and oven space was limited to range ovens in 21 schools. Only 10 had good dishwashing facilities; i.e., either three-compartment sinks for washing, rinsing and sterilizing dishes, or dishwashers. There was little power equipment installed; no other institution-type labor-saving equipment was available. On the whole, Iowa schools were provided with less equipment than were other schools studied (7, 10).

The 25 schools had some type of refrigeration; large reach-in units were in 15 and small, in 10. In this respect they resembled schools studied by Dreisbach and Handy (7); all had some kind of refrigeration.

Most of the high and elementary schools in cities with population of 50,000 or over had more in-

TABLE 10. INSTITUTION-TYPE EQUIPMENT AVAILABLE IN 25 IOWA SCHOOLS.

Equipment	High (no.)	Elementary (no.)	With 12 grades (no.)	Total schools (no.)	(%)
Range	6	4	7	17	68
Deck oven	1	2	1	4	16
3-compartment sink	0	0	3	3	12
Dishwasher*	4	1	2	7	28
Electric mixer	4	3	0	7	28
Vegetable peeler	2	0	1	3	12
Grinder & slicer	0	0	0	0	0

\* All but one were institution-type machines.

stitution-type equipment than the elementary schools in smaller towns and schools with 12 grades regardless of numbers served. Among schools with 12 grades, the number of lunches served seemed to make little difference in the type and amount of equipment available. This was similar to what Habig (10) found; Dreisbach and Handy (7), on the other hand, found that more power equipment was available in schools where larger numbers were served.

Use of different kinds of institution-type equipment had varying effects on the division of total labor time for preparation, serving and cleaning. In general, use of this equipment increased the amount and proportion of labor time devoted to cleaning. This was true of the steam tables and refrigerated units used in three high schools, as well as of electric mixers and vegetable peelers. Even small equipment items as trays, used instead of divided plates, added to the time spent in cleaning. High schools usually had more adequate equipment than others, and their lunch personnel spent less time in preparation and dishwashing, but more in cleaning. The average percentage of time spent for preparation in schools with 12 grades, however, was double that for serving and approximately one-third more than for cleaning.

The use of institution-type equipment is likely to influence the kind of lunches served as well as the amount of time spent in preparing and serving them. According to standards suggested, none of the schools with 12 grades had adequate kitchen equipment, and, as a result, it was difficult to standardize the number and size of portions of food served in these schools.<sup>7</sup> Moreover, the types of menu items that could be prepared were definitely limited by lack of equipment, especially of adequate ovens. A further effect of differences in equipment is suggested by the fact that it was chiefly in the schools having inadequate equipment that the employees seemed to work more strenuously and to have more difficulty in preparing food on time. It was evident that these Iowa schools needed more adequate institution-type equipment to make more effective use of management resources.

#### INCOME AND EXPENDITURES

In many enterprises, managers measure their success in terms of profits; managers of school lunch programs, however, have no such simple measure. Although in most communities the school lunch programs are expected to be self-supporting, their success is measured not in terms of profits but of the contribution they make to the well-being of the pupils who eat the lunches and the extent to which the lunch program has become an integral part of the total school program. It is

<sup>7</sup> Recommendations covered ranges, sinks, dishwashers, refrigerators, tables, counters, trucks, kitchen machines, storage and small equipment. Authors recognized that equipment needs depend on number and type of meals served and that "minimum requirements" suggested were far above the facilities and equipment many schools provided (25).



important, therefore, that income and expenses be effectively controlled.

So that comparisons might be made among the Iowa schools and with other groups of schools for which data were available, the annual financial records for the 22 schools were analyzed in two ways. The total figures for each category of expense and income for each group of schools were divided by: (1) the number of revenue meals served during the year and expressed as "per meal" costs and receipts and (2) total annual income and expressed as percentages of total income.

#### PER MEAL COSTS

Twenty-two schools reported annual food and labor costs, and a number reported "other" costs, classified in more or less detail. The average amount and range of each of these types of costs and of total costs, reduced to a per meal basis, are shown in table 11.

Variations among food costs were doubtless related to differences in amounts and kinds of food served, in amounts of USDA-donated commodities used and in prices of food. In large towns and cities most of the food was bought at wholesale prices; in smaller places, it was bought from wholesale dealers or local grocers, sometimes at a discount from regular retail prices. Analysis of covariance indicated that when food costs for the year for 22 schools were adjusted to a common mean number of revenue lunches served during the year, differences among the three groups of schools were not significant.

The number and type of workers employed, the rate of wages paid and the number of special functions for which additional wages were paid were all related to per meal labor costs. Wages were \$60 to \$140 per month; part-time workers received 58 to 85 cents per hour. In general, employees in larger cities and those experienced in quantity food service received highest wages. When labor costs for the year for 22 Iowa schools were adjusted to a common mean number of revenue lunches served during the year, analysis of covariance showed that there were significant differences among the three groups of schools.

Thirteen schools served less than 200, and nine served 200 or more lunches. The average labor cost of 8 cents was exceeded by 11 of the 13, and by only two of the nine larger programs. These two classifications of schools were about equally divided on the basis of average per meal food costs (15 cents) and other costs (3 cents) so ap-

TABLE 11. PER MEAL COSTS (IN CENTS) FOR THE SCHOOL YEAR 1948-49.

Schools	Food costs		Labor costs		Other costs		Total costs	
	av.	range	av.	range	av.	range	av.	range
4 high	17	10-25	10	7-19	5	3-12	32	20-48
4 elementary	13	7-18	8	4-13	3	1-6	24	16-38
12 with 12 grades	15	11-19	8	6-11	2	*-4	25	22-31
22 total schools	15	7-25	8	4-19	3	*-12	26	16-48

\* Less than 1 cent.

parently other factors in addition to the number served affected these costs. These findings were consistent with those of Emmons (9) and Waye (30).

Differences among individual schools and among the groups of schools in per meal "other" costs reflected differences in: (1) number and amount of other items purchased and sold in connection with the school lunch and (2) amount of overhead expenses charged against the school lunch program by the school or school system.

In some schools, the cost of milk (sold separately from the lunch), candy, ice cream and food for banquets were important items. For example, in two high and two elementary schools the cost of food for banquets accounted for 5-10 percent of total expenditures. In certain of these schools, this food was sold below cost, so the lunch program was, in effect, subsidizing banquets to promote public relations or welfare programs. The advisability of such subsidizing is questionable. No school with 12 grades reported expenditures for candy, ice cream or food for banquets, and only two reported expenditures for "milk only."

The amount of operating expenses borne by school lunch programs varied considerably among the schools. Space and janitor service were provided without charge by the board of education in all schools. In 15 schools, expenses for repair and replacement of equipment were paid from school lunch income. In high and elementary schools in cities of over 50,000 population, expenses for utilities, laundry, cleaning supplies, garbage removal and prorated operating costs were paid from lunch income. The prorated amount charged each month in some schools paid for the services of the city school supervisor, some supplies and equipment. In one school, the home economics teacher was paid a small amount from lunch funds for managing the program.

Analysis of covariance indicated that when the other costs for the year for 22 schools were adjusted to a common mean number of revenue lunches served during the year, differences among the three groups of schools were highly significant.

Average per meal total costs in individual schools and for the three groups of schools reflected variation in the three types of costs included in the total. The highest cost, 48 cents, was three times the lowest; the average for 22 schools was 26 cents. Analysis of covariance indicated that there were differences among the three groups of schools when total costs for the year for 22 Iowa schools were adjusted to a common mean number of revenue lunches served during the year.

#### PER MEAL RECEIPTS

In the 22 schools for which annual financial reports were available, school lunch programs received some income in addition to that received from the sale of lunches. Average per meal re-



TABLE 12. PER MEAL RECEIPTS (IN CENTS) FOR THE SCHOOL YEAR 1948-49.

Schools	Lunches		Federal reimbursement		Milk, candy, ice cream, banquets		Other		Total receipts	
	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
4 high*	26	17-36	2	0-7	4	1-10	2	0-5	33	20-47
6 elementary	19	9-26	5	5-6	2	7-7	†	0-†	26	16-39
12 with 12 grades	20	16-26	5	5-6	†	0-1	†	0-†	25	21-31
22 total	21	9-36	4	0-7	2	0-10	1	0-5	27	16-47

\* Only two served Type A meals and received reimbursement.

† Less than 1 cent.

ceipts and range for the three groups of schools are shown in table 12.

Average per meal receipts from lunches sold in the three groups of schools were not identical with the prices charged for lunches sold to pupils because average daily revenue lunches served included some free lunches as well as lunches sold to adults at different prices.

The federal government gave two kinds of aid to schools cooperating in the National School Lunch Program: (1) federal reimbursement and (2) USDA-donated commodities. Schools in which Type A lunches were served received the maximum reimbursement of 6 cents for each complete Type A lunch served to a pupil. The importance of this income is evident in a comparison of costs and receipts as shown in table 13. In every school total costs were greater than total receipts without reimbursement. In the absence of federal reimbursement, prices of the lunches would have to be raised, costs lowered, or deficits would have to be met from sources other than school lunch programs.

The monetary value of surplus commodities donated by the federal government to school lunch programs is not shown directly in summaries of receipts and costs, because only cash income and outlays are recorded in these accounts. Commodities may decrease the prices charged for lunches and increase the nutritional value of the lunches. The average per meal value of USDA-donated commodities used on the day observed in the 22 schools where Type A lunches were served was 3.6 cents; amounts varied in individual schools from 1 to 7 cents. Similar figures for the school year were not available. James (11) reported in 1949 that the average per meal value of donated commodities used in a rural Iowa school was 4 cents, and Rogers (20) reported in 1952 that fewer commodities and smaller amounts resulted in a decrease to 2.7 cents as the average for 83 Iowa schools with 12 grades. Even if 3 cents was considered as the average, the value of the donated commodities amounted to one-fifth of the food purchased.

TABLE 13. AVERAGE PER MEAL COSTS AND RECEIPTS (IN CENTS) FOR 20 IOWA SCHOOL LUNCH PROGRAMS.

Schools	Total per meal costs	Per meal receipts	
		Without federal reimbursement	With federal reimbursement
2 high	44	37	44
6 elementary	24	21	26
12 with 12 grades	25	20	25
20 total schools	26	22	27

There was wide variation among the individual schools and among the three groups of schools in the income obtained from the sale of milk, food for banquets, candy and ice cream. One high school lunch program obtained a fairly substantial income from such other sources as the sale of food for use in the home economics laboratory and for refreshments for student meetings and social functions, donations, or the sale of leftover food. In most of the schools, however, the amount from these sources was negligible.

For the 22 schools and for each of the three groups of schools, total cash receipts for the year were greater than total expenditures. Surpluses in 16 schools ranged up to 14 percent of total cash receipts; six recorded annual deficits ranging up to 8 percent. Although school lunch programs were expected, in general, to be self-supporting, most administrators indicated that deficits at the end of the year were usually paid from school funds. A county health organization paid the deficit for one program which served a large number of free lunches.

#### SOURCE AND EXPENDITURE DISTRIBUTION OF INCOME

In 18 of the 22 schools, the cost of food for lunches and labor accounted for between 80 and 98 percent of total income. In the Iowa study, the total cost of employees' meals was included under labor costs, including cost of food, which was deducted from food costs. Cost of insurance was also included under labor costs. Hence one would expect to find the percentage of food costs lower and labor costs higher in the Iowa study than in those in which labor costs were more narrowly defined. James (11), however, used the same accounting methods and obtained similar results for food and labor costs.

The wide range in per meal expenditures in the Iowa schools indicated a need for better control of all types of expenditures and more uniform record keeping. Records of specific income and expenses involved in preparation and service of the actual lunch should be kept separate from those of other items sold. Perhaps USDA-donated commodities could have been used more effectively in some schools to decrease the cost of food in relation to prices charged pupils and adults.

#### NUTRITIVE VALUE AND PERCENTAGE OF STANDARD PORTION OF LUNCHES CONSUMED, IN RELATION TO COST AND PREPARATION TIME

Data obtained from 24 Iowa schools were classified to indicate relationships between the nutritive



value of lunches served and amounts of certain resources used in their preparation on the day observed. As shown in table 14, data were tabulated according to the increasing number of nutrients deficient in the lunches prepared. The amount of each of nine nutrients supplied by a standard portion of all food items included in the lunch was used as the index of nutritive value. Resources used were represented by: per meal food cost, value of USDA-donated commodities, total monetary value of lunch and per meal preparation time. The number of standard portions prepared was used in calculating per meal costs and preparation time, so these values differ somewhat from corresponding averages based on the number of revenue meals served.

Data presented in table 14 bear out, to some extent, James' (11) conclusion that the lunches that were most adequate, nutritionally, were usually the most expensive. Of the seven lunches that were deficient in only one nutrient, five had per meal food costs that exceeded the average for all schools, 15.3 cents. One could not conclude, however, that higher than average food costs insured nutritional adequacy, as three of the nine lunches that were deficient in five or more nutrients also had per meal food costs above the average.

There was no clear-cut relationship between the value of donated commodities used and the nutritive value of lunches. It is, however, interesting to note that for the school using the highest

TABLE 14. PER MEAL FOOD COST, VALUE OF USDA COMMODITIES, PREPARATION TIME AND PERCENT OF FOOD CONSUMED IN RELATION TO THE NUTRIENTS SUPPLIED BY STANDARD PORTIONS IN 24 IOWA SCHOOL LUNCHES ON THE DAY OBSERVED.

School	Per meal food cost (cents)	Value of USDA comm. (cents)	Total mon. value of lunch (cents)	Per meal prep. time (min.)	Food consumed (%)	Nutrients deficient (no.)
111	20.9	03.1	24.0	3.17	95.18	1 <sup>a</sup>
112	16.2	08.0	24.2	3.25	97.61	1 <sup>b</sup>
211	18.2	03.0	21.2	3.48	98.73	1 <sup>a</sup>
212	26.8	—	26.8	2.73	99.50	1 <sup>c</sup>
231	16.8	02.0	18.8	3.00	93.35	1 <sup>d</sup>
232	10.0	04.1	14.1	3.00	99.06	1 <sup>d</sup>
235	12.7	04.3	17.0	2.36	93.74	1 <sup>d</sup>
233	20.3	03.4	23.7	2.67	98.87	2 <sup>e, f</sup>
234	10.6	06.2	16.8	2.15	95.09	2 <sup>b, d</sup>
123	18.2	03.6	21.8	2.07	95.07	3 <sup>d, e, g</sup>
221	16.1	04.8	20.9	1.62	90.91	3 <sup>a, d, e</sup>
2311	16.3	04.6	20.9	1.60	94.60	3 <sup>d, f, g</sup>
223	13.6	05.2	18.8	1.29	92.97	4 <sup>b, d, f, g</sup>
238	13.3	03.0	16.3	1.76	97.52	4 <sup>a, d, e, f</sup>
2312	17.5	01.3	18.8	1.97	86.36	4 <sup>a, d, e, f</sup>
122	10.3	02.5	12.8	1.08	92.35	5 <sup>b, d, f, g, h</sup>
213	10.7	01.8	12.5	1.44	99.31	5 <sup>a, b, d, e, i</sup>
237	14.5	04.0	18.5	2.86	95.84	5 <sup>a, b, d, f, g</sup>
2313	12.4	05.8	18.2	2.46	91.94	5 <sup>b, d, f, g, h</sup>
121	15.5	00.9	16.4	2.18	98.60	6 <sup>c, d, e, f, g, h</sup>
236	08.8	04.1	12.9	1.98	93.38	6 <sup>a, b, d, f, g, h</sup>
2310	15.7	02.1	17.8	2.08	94.10	6 <sup>d, e, f, g, h, i</sup>
222	19.3	01.3	20.6	2.17	93.22	7 <sup>b, c, d, e, f, h, i</sup>
113	13.0	—	13.0	0.45	99.32	9
Average	15.3	03.6	18.6	2.20	94.92	
Range	26.8 to 8.8	8.0 to 0.9	26.8 to 12.5	3.5 to 1.1	99.5 to 86.4	

<sup>a</sup> Vitamin A  
<sup>b</sup> Niacin  
<sup>c</sup> Ascorbic Acid

<sup>d</sup> Calories  
<sup>e</sup> Calcium  
<sup>f</sup> Iron

<sup>g</sup> Thiamine  
<sup>h</sup> Protein  
<sup>i</sup> Riboflavin

value of commodities the cost of purchased food was practically the same as in the school where the lowest value of commodities was used. In the former school, the protein value of lunch approximated the highest reported, and the lunch was deficient in only one nutrient. In the school where the lowest value of commodities was used, the protein value was lowest, and the lunch was deficient in six nutrients.

Per meal preparation time appeared to be related to nutritive value of the lunches. All lunches deficient in only one nutrient required more than average preparation time. The lunch deficient in all nutrients required the lowest preparation time and was the only one that required less than 1 minute. The more adequate lunches included more menu items and items that required more time for preparation, such as vegetables, salads and main dish items.

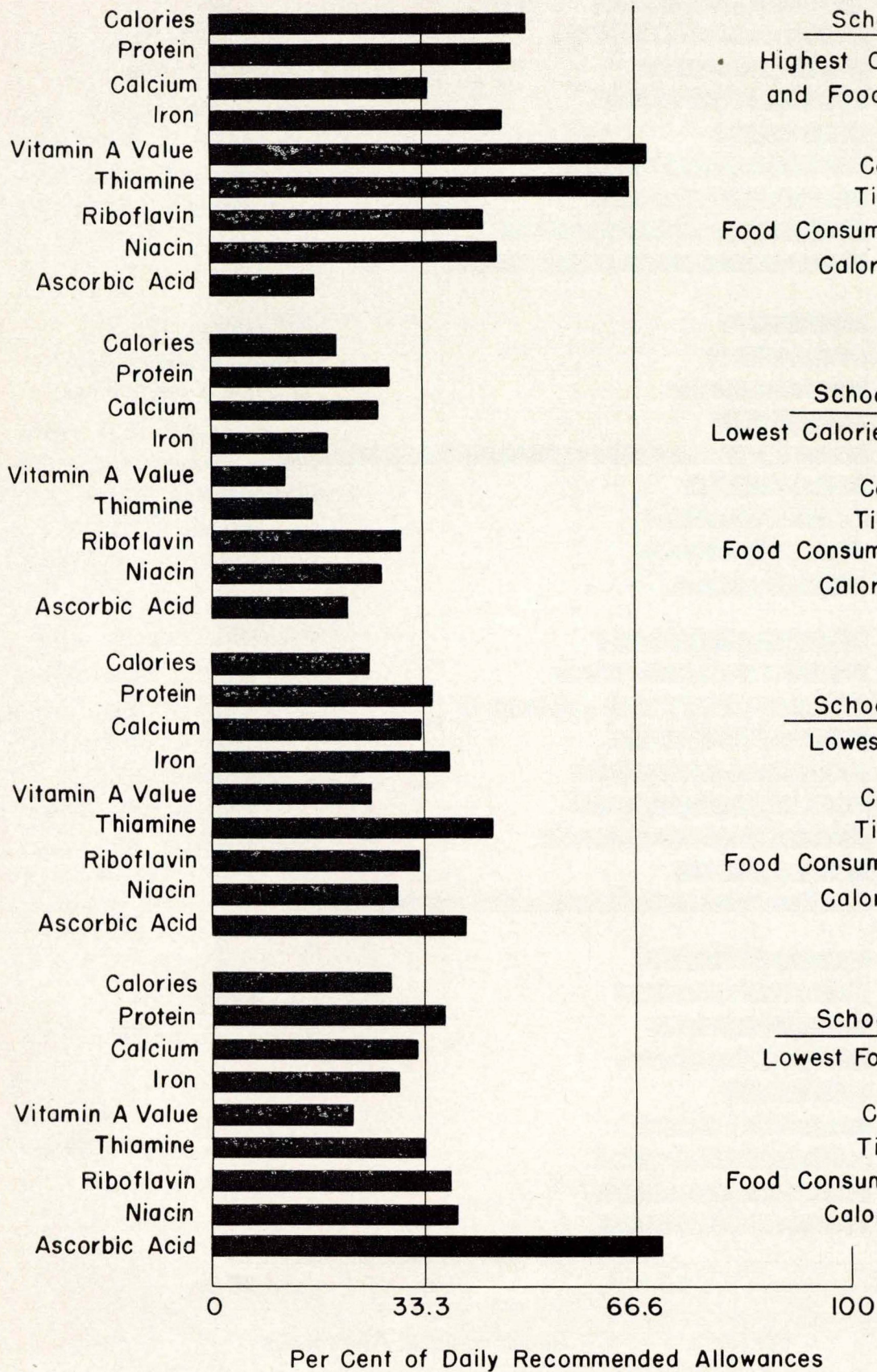
Some of the more specific relationships for the individual schools between per meal total monetary value, per meal preparation time, percentage of food consumed and nutrients supplied are shown in figs. 1 and 2. These figures illustrate the percentage of the recommended daily dietary allowances which were provided by eight lunches representing the extremes in per meal monetary value, preparation time, value of commodities used, percentage of calories or protein provided and food consumed. The amount of calories or protein afforded by these lunches was emphasized because it is generally recognized that some school lunches provided inadequate amounts for older children.

In general more nutrients were provided in adequate amounts in lunches where either the per meal monetary value, preparation time, value of commodities used or the amount of calories or protein were highest for all lunches served. For example, the lunch in School 212, which included the highest amount of calories and cost the most, also supplied 47.43 percent of the protein allowance, and the greatest amount was consumed; preparation time was relatively high.

The two lunches that illustrated extremes in the number of calories provided were the only two self-selected lunches of the 24 analyzed. Seventy-five of the 471 students eating in the cafeteria in School 212 selected the lunch analyzed in the present study and paid 43 cents; 86 of the 481 students in School 113 selected a plate lunch combination and paid 30 cents. Selling prices of both of these combination lunches were higher than the average price charged for the Type A lunches.

The data presented in table 14 and figs. 1 and 2 indicated that, on the day observed, the menu items included in the more nutritionally adequate lunches were relatively more expensive and usually required more preparation time than did the menu items in the lunches which were nutritionally less adequate. The kind of equipment available, such as a mixer, deck oven or steamer, was a factor influencing the variety of menu items possible to prepare in a school. As previously discussed, factors other than cost, labor time and the nutrients provided apparently influenced the amount of food consumed in the schools observed.





School 212  
 • Highest Calories, Cost  
 and Food Consumed

Cost: 26.8 cents  
 Time: 2.73 min.  
 Food Consumed: 99.50 %  
 Calories: 49.32 %

School 113  
 Lowest Calories, Lowest Time

Cost: 13.0 cents  
 Time: 0.45 min.  
 Food Consumed: 99.32 %  
 Calories: 19.28 %

School 213  
 Lowest Cost

Cost: 12.5 cents  
 Time: 1.44 min.  
 Food Consumed: 99.31 %  
 Calories: 24.80 %

School 2312  
 Lowest Food Consumed

Cost: 18.8 cents  
 Time: 1.97 min.  
 Food Consumed: 86.37 %  
 Calories: 28.00 %

Fig. 1. Per meal food cost and preparation time and percent of food consumed in relation to the calories and other nutrients supplied by four school lunches.



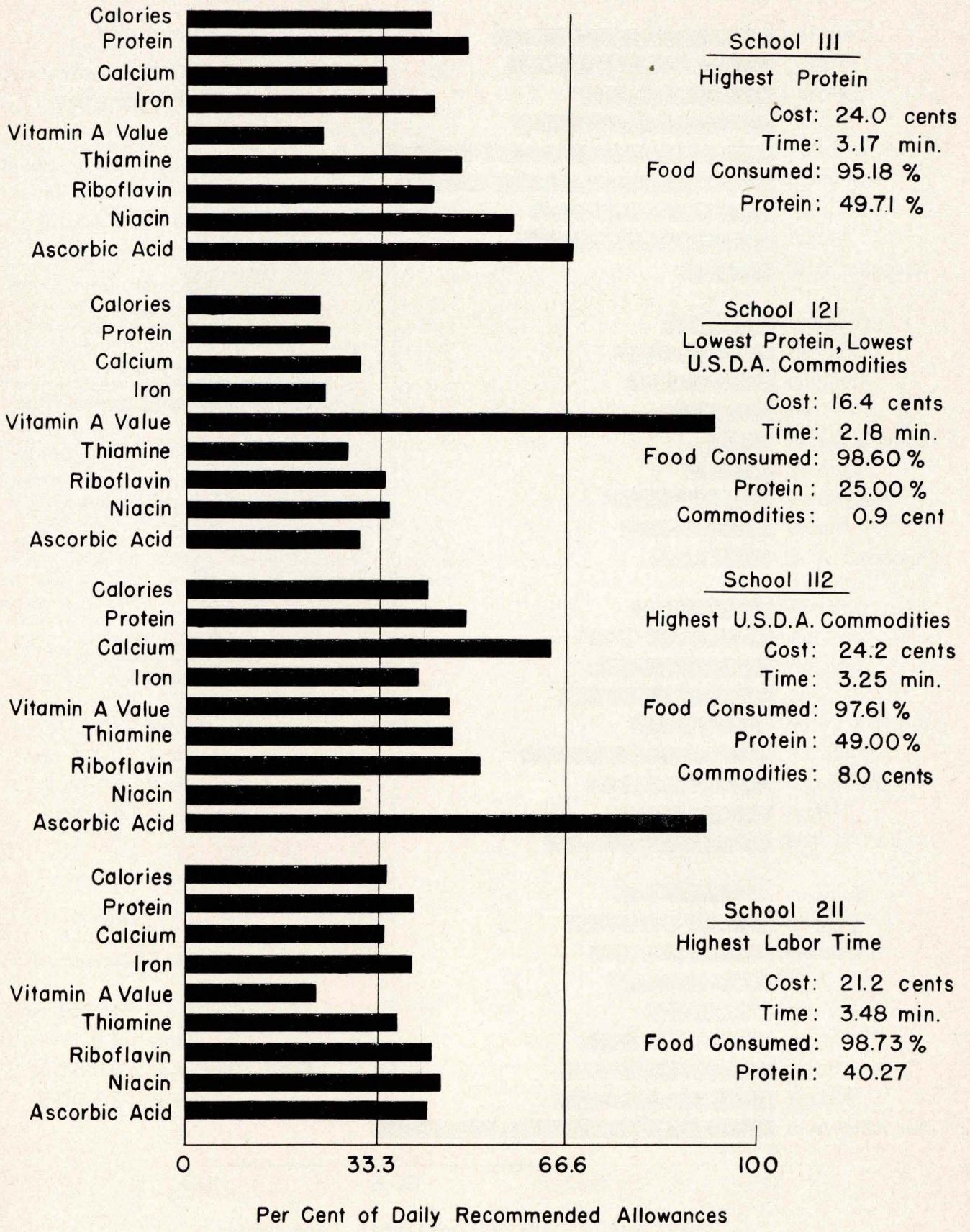


Fig. 2. Per meal food cost and preparation time and percent of food consumed in relation to the protein and other nutrients supplied by four school lunches.



## APPENDIX

### A DESCRIPTION OF THE SURVEY TECHNIQUE

#### THE SAMPLE

The sampling procedure was planned by a representative of the Statistical Laboratory of the Iowa State College in cooperation with representatives from each of the three states participating in the regional school lunch project and representatives from the Bureau of Human Nutrition and Home Economics.<sup>8</sup>

The public schools in Iowa were classified in four categories:

1. Those from which no information about lunch programs was available
2. Those supplying information
  - (a) Those in which no food was served
  - (b) Those in which lunch programs provided:
    - (1) A full meal
    - (2) Supplementary food.

Participants planning this research project believed that lunch programs in certain types of schools might present problems peculiar to these schools. Consequently all schools in each of the

<sup>8</sup> Now Institute of Home Economics, Agricultural Research Service, USDA.

TABLE A-1. CLASSIFICATION, NUMBER AND SIZE OF SAMPLE OF IOWA PUBLIC SCHOOLS SERVING FULL MEALS DURING 1948-49.

Population groups	School groups					
	Junior and senior high		Elementary		Grades 1-12 in one unit	
	Total	Sample	Total	Sample	Total	Sample
1. Schools in cities with a population of 50,000 or over	26	3	4	3	0	0
2. Schools in cities with a population of under 50,000 and schools having grades 1 through 12 in one unit in rural areas	41	3	26	3	525	13
3. Rural elementary schools	0	0	0	0	0	0
<b>Total</b>	<b>67</b>	<b>6</b>	<b>30</b>	<b>6</b>	<b>525</b>	<b>13</b>

TABLE A-2. CODE NUMBERS FOR SCHOOLS IN WHICH MANAGEMENT STUDIES WERE CONDUCTED.

Population groups	Type of school		
	Junior and senior high	Elementary	Grades 1-12 in one unit
Pilot schools	110	—	230
1. Schools in cities with a population of 50,000 or over	111	121	—
	112	122	—
	113	123	—
2. Schools in cities with a population of under 50,000 and schools in rural areas having grades 1 through 12 in one unit	211	221	231
	212	222	232
	213	223	233
	—	—	234
	—	—	235
	—	—	236
	—	—	237
	—	—	238
	—	—	239
	—	—	2310
3. Rural elementary schools	—	—	2311
	—	—	2312
	—	—	2313

four categories described were classified further into three groups: junior and senior high, elementary, and schools having grades 1 through 12 in one unit. Population of the city or town was also suggested as a factor that might affect various phases of school lunch programs, and all schools were classified further into categories referred to as population groups. Three population groups were set up as shown in table A-1.

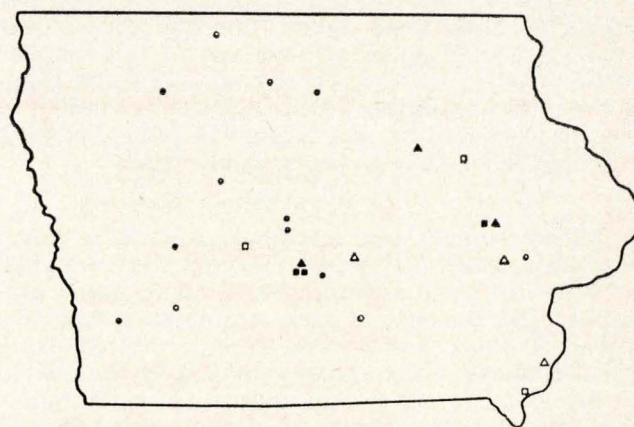
Code numbers and locations of schools are shown in table A-2 and fig. A-1.

#### COLLECTING THE DATA

The 25 schools in the sample were visited during the period from October 1948 through May 1949.

Pilot studies in the two schools had indicated the advisability of being at a school all day preceding the day on which specific data were to be collected. Before a school was visited the administrator was consulted and a date selected. Days preceding or following vacations were avoided as well as any day on which special school events were being held. Data were collected in each school on a Wednesday considered typical for the operation of the school and the lunch program.

Upon arrival Tuesday morning, the interviewer held a prearranged conference with the school administrator to explain plans for collecting the data and obtain necessary information for carrying out the plans. Before lunch was served, a brief conference was held with the person who managed the lunch program to explain the purpose of the study. Details concerning the research were discussed after the lunch service was observed. At



Iowa schools in cities of 50,000 population and over:

- ▲ Junior and senior high schools
- Elementary schools

Schools in cities and towns of under 50,000 population and schools having grades 1 through 12:

- △ Junior and senior high schools
- Elementary schools
- Schools having grades 1 through 12.

Fig. A-1. Location of schools in management study.



that time the general work schedule for each employee was obtained; this served as a guide for recording the labor time on Wednesday. Wednesday's menu, recipes and cost of food were recorded then, if they were available. The kitchen, dining room and storeroom layout and equipment were drawn on Tuesday afternoon.

On Wednesday, the data concerning the lunch and time expended by individual workers were recorded. In the larger schools, pupils, teachers or employees assisted when students were returning unconsumed food. Before leaving, the interviewer held a final conference with the school administrator to obtain information concerning the financial policies of the lunch program and other data not previously acquired.

#### COMPILATION OF DATA

##### NUMBER OF LUNCHESES SERVED

The total number of lunches served included those served to all pupils and adults, including workers, who ate the lunch on the day observed. Lunches served to pupils who were unable to pay were classified as "free." The percentage of total enrolled pupils who were participating was calculated on the basis of the number of all pupils eating the school lunch.

Revenue lunches served on the day observed refers to all lunches served to customers, including free lunches but excluding lunches served to student and adult workers. The daily average number of revenue lunches for the school year 1948-49 was determined by dividing the total number of revenue lunches served during the year by the number of days the lunch program was operated. The number of revenue lunches served was used as the basis for calculating the per capita receipts, costs, labor time and certain per capita space allowances. This use of the number of persons served and accommodated by the regular service and dining room facilities is similar to the method used by Augustine (1) for converting cost and labor time to a per capita basis.

##### NUTRITIVE VALUE OF THE SCHOOL LUNCHESES

All ingredients used in the preparation of lunch in each school on the day observed were weighed as were the total amounts of all menu items prepared. The amounts of each of nine nutrients provided by every menu item were calculated using the food composition tables compiled by the United States Department of Agriculture (27). To determine the nutritive values of a standard portion of each food item, the total value of each of the nutrients supplied by the food item was divided by the number of standard portions prepared. Amounts of each nutrient provided by the standard portion of the menu item prepared were totaled to show nutritive values afforded by the complete lunch.

##### ACCEPTABILITY OF FOOD SERVED

To determine the general kinds of food returned

in greatest quantities in each of the groups of schools and for the 24 schools, the menu items were classified into eight types of foods. Salads included vegetable and fruit salads and any vegetable served raw if another vegetable was included on the menu. Vegetables included all cooked ones and raw vegetables if no cooked ones were served. Potatoes were included with the main dish if served as a part of that item. Main dish items represented the main protein food of the meal. Sandwiches which contained cheese, peanut butter, or other protein were classified with other breads and sandwiches. Desserts did not include raw and canned fruits served as desserts; these fruits were classified separately. Fruit juice was either orange, grapefruit or a mixture of the two.

#### LABOR TIME

Total daily labor time scheduled represented the total hours which, according to the school records, the employees were expected to work. The total daily labor time for the menu on the day observed included the time actually used in preparing food for the menu observed, and in serving, cleaning, other work, resting and eating on the day data were collected. Time used for preparing food on Tuesday for Wednesday's menu was included in the total labor time for the day observed; time required on Wednesday for preparing food for Thursday was excluded.

The number of lunches served per man-hour of labor in each school was calculated by dividing the number of revenue lunches served by the total hours of labor time required for preparing and serving the menu on the day observed.

The number of minutes of labor time expended per lunch served in each school was calculated by dividing the total number of minutes of the total daily labor time for the menu on the day observed by the number of revenue lunches served on that day.

Labor time for preparation included the time involved in food production for the menu observed: i.e., for assembling materials and equipment; measuring, weighing and mixing ingredients; sorting, cleaning, trimming and cutting foods; making salads and sandwiches and cooking other foods; portioning food if this was done during preparation; transporting food from one preparation center to another; refrigerating or storing food during preparation and prior to serving time and putting away unused ingredients.

Service included the time spent for serving the meals: i.e., for assembling and arranging dishes, silverware, trays, napkins, straws and other service equipment; setting up serving counter; moving food from refrigerator, storeroom, range or work center to serving area; portioning those foods not portioned during preparation; putting food into individual dishes and on plates; returning food to the kitchen for reheating between shifts and replenishing the serving counter with food.

Cleaning included the time used for cleaning and



maintaining the lunchroom facilities: i.e., for clearing the serving counter and storing leftover food; scraping and stacking soiled dishes; washing, drying and storing dishes, silverware, glassware, trays, pots, pans and other utensils; wiping table tops; cleaning work surfaces, range, refrigerator, and other equipment; sweeping and cleaning floors and replacing furniture and equipment after cleaning.

Included as other work was the time spent for writing menus, ordering food and other supplies, checking deliveries, giving directions to workers, taking inventory, preparing records and carrying supplies to and from the storeroom. Time used for resting, waiting, drinking coffee and eating meals was classified as other.

#### SPACE ALLOWANCES

The total kitchen area included the space used for preparing food, washing dishes and serving. In those schools where food was prepared in the home economics laboratory, only the space used by the school lunch personnel for preparing food, washing dishes and serving was included as kitchen area. The number of square feet of kitchen space per revenue lunch served in each of 25 schools was determined both on the basis of the number served on the day observed and the average daily number served during the school year. The figure determined on the latter basis was considered to be more representative of the capacity for which the space and facilities of the lunchroom were planned.

The dining room area included the space provided for the tables and chairs or benches used for dining room service for the school lunch room. If a gymnasium was arranged at noon as a dining room, that space was considered as dining room area. If the students ate in classrooms or other space not arranged specifically for school lunch service, the space was not considered.

**Basic food route.** The total basic food preparation route included the distance from the storeroom to the sink supplying water for preliminary cleaning to the cook's work table, to the range, to the serving counter. This route was drawn and measured on the kitchen layout.

#### PER MEAL RECEIPTS AND COSTS

Per meal receipts and costs for the day observed and the year were calculated on the basis of the number of revenue lunches served. Receipts included income from lunches, banquets, milk, candy, ice cream, federal reimbursement and others. Total receipts were used to show the relationship between total receipts and costs since labor and other costs were not classified with reference to the labor and other expenses used for preparing and serving banquets and for selling other items.

The per meal food cost included the cost of food

for lunches, excluding the cost of employees' meals and the cost of food used for banquets and the milk, ice cream and candy sold in addition to the lunch. Labor cost included the wages paid, the cost of employees' meals and the amount paid from school lunch funds for Iowa Old Age Survivors Insurance. Other costs included the cost of food used for banquets, food items sold in addition to the lunch and other operating expenses.

#### COST OF EACH FOOD ITEM AND PREPARATION TIME PER STANDARD PORTION

To determine the cost of a standard portion of each food item, the cost of the food purchased and used in the preparation of the item was divided by the number of standard portions of that item prepared. These portion costs of the menu items were totaled to determine the food cost per lunch prepared. The monetary value of the USDA-donated commodities used per lunch was calculated using the same method. The total monetary value of the meal was the cost of the food purchased plus the value of the commodities. To find the per portion preparation time, the labor time expended for the preparation, exclusive of other labor time, was divided by the number of standard portions prepared. The per portion preparation times for the items in a lunch were totaled to find the preparation time per lunch.

#### STATISTICAL ANALYSES

TABLE A-3. DATA USED FOR ESTIMATING SAMPLE SIZE FOR FURTHER MANAGEMENT STUDIES.

	s <sup>2</sup> *	t	d†	n <sub>0</sub> ‡	n§
High schools, N = 67					
Labor time	7.7	2	0.25 min.	492.8	59
Kitchen area	8.8	2	0.5 sq.ft.	140.8	45
Dining room area	25	2	1 sq.ft.	100	40
Dining table area	0.88	2	0.1 sq.ft.	352	58
Food cost	56.9	2	0.5 cent	910.4	62
Labor cost	31.6	2	0.5 cent	505.6	59
Other costs	16.3	2	0.5 cent	260.8	53
Total cost	13.9	2	0.25 cent	889.6	64
Elementary schools, N = 30					
Labor time	8.7	2	0.25 min.	556.8	28
Kitchen area	0.65	2	0.5 sq.ft.	10.4	8
Dining room area	7.8	2	1 sq.ft.	30.8	15
Dining table area	0.15	2	0.1 sq.ft.	60	20
Food cost	16.3	2	0.5 cent	260.8	27
Labor cost	10.9	2	0.5 cent	174.4	20
Other costs	4	2	0.5 cent	64	21
Total cost	5.4	2	0.25 cent	345.6	28
Schools with 12 grades, N = 525					
Labor time	2.3	2	0.25 min.	147.2	115
Kitchen area	1.2	2	0.5 sq.ft.	19.2	19
Dining room area	5	2	1 sq.ft.	20	19
Dining table area	0.17	2	0.1 sq.ft.	68	60
Food cost	5.9	2	0.5 cent	94.4	80
Labor cost	2.8	2	0.5 cent	44.8	41
Other costs	1.9	2	0.5 cent	30.4	28
Total cost	0.8	2	0.25 cent	51.2	47

\*s<sup>2</sup> = variance

†d = one-half the confidence interval

$$\ddagger n_0 = \frac{t^2 s^2}{d^2}$$

$$\S n = \frac{n_0}{1 + \frac{n_0}{N}}$$



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