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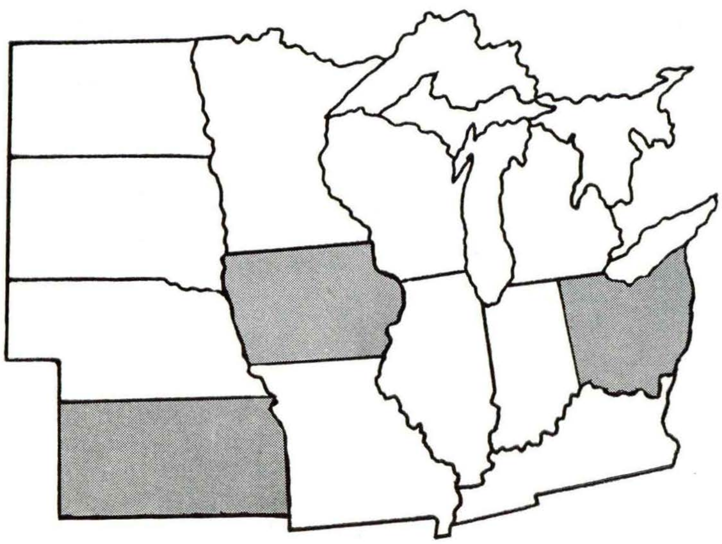
NUTRITION OF 9-, 10- AND 11-YEAR-OLD PUBLIC SCHOOL CHILDREN IN IOWA, KANSAS AND OHIO

I. DIETARY FINDINGS



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FOREWORD

Good nutrition is a potent force in making healthful living possible. It is important for all age groups. School children's dietary patterns were presumed to vary greatly, but little detailed information on nutrient intake and nutritional status of 9-, 10- and 11-year-old children was available, and few efforts have been made to determine the effect of school lunch participation on nutritional status.

Through the mechanism afforded by the pattern of regional research, opportunity was presented for obtaining desired information about food and nutrient consumption of thousands of children in Ohio, Kansas and Iowa under their home and school environments and to relate these findings to nutritional status.

The results of the dietary studies are reported in this bulletin and may be helpful in evaluating nutritional requirements of children, in determining the focal points of nutrition educational programs, and in formulating policies and plans of the school lunch or other programs to improve the nutrition of children.

Much more information is needed concerning the nutritional requirements of children, the amounts and kinds of food they eat, the factors which influence their dietary patterns, their concurrent physical and chemical growth and their subsequent health histories. Continued studies and additional publications will contribute to the pool of knowledge being accumulated in this field.

W. E. Krauss,
Administrative Advisor.

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SUMMARY

The mean nutrient consumption for 3 school days of 9-, 10- and 11-year-old public school children of Iowa, Kansas and Ohio is presented. Except for calcium, the average intake levels of boys and girls for each year of age and each state conformed to or exceeded the Recommended Dietary Allowances of the National Research Council. Frequently, however, individual intakes were somewhat low in calcium, ascorbic acid and vitamin A value. This is important to consider when planning educational programs and other measures for improving nutrition. Only 10, 21 and 25 percent of the boys and 8, 9 and 13 percent of the girls in Kansas, Ohio and Iowa, respectively, had diets which fully conformed to the allowances. Therefore, the optimum levels of nutrient intake for school children in these states probably have not been reached. Fortunately, the proportion of children with exceedingly poor intakes was relatively low.

At these ages, the nutrient content of the boys' diets generally exceeded that of the girls'. Trends of nutrient intake were more uniform for boys than for girls. Relatively smaller differences were noted among age-sex groups for calorie and protein intakes than for the intakes of other nutrients.

There were some differences in nutrient consumption among the children of the different states. The children in Ohio tended to have the highest intakes in calcium, iron, thiamine, riboflavin, niacin and protein (boys only). Diets of Iowa children were usually highest in food energy value, vitamin A and ascorbic acid while the diets of Kansas children were superior to the others only in the protein intake of the girls. The diets of Iowa children were observed to be the poorest of the three states in protein, iron and thiamine; diets of Kansas boys poorest in vitamin A. Diets of Iowa and Kansas children were approximately equal in riboflavin and niacin content. Ohio children ranked lowest only in the energy value of the girls' diets.

Among the children who participated in school lunch programs, the frequency of low intakes of most nutrients for the boys and of several nutrients for the girls was reduced. The changes were marked among the nutrients most frequently lacking in the diets; but further efforts are needed to reduce the relatively large proportions of children with low intakes of calcium, ascorbic acid and vitaman A value to reasonable minima.

Boys averaged approximately 3 cups of milk daily; girls 2.5 to 2.9. Diets were well-supplied with protein-rich and cereal foods. Intakes of the vitamin-rich fruits and vegetables were less than usually are recommended. Children with the school lunch consumed more of the vitamin C-rich foods than the non-lunch children, but the total intake of milk per day was not higher for the lunch than the non-lunch participants.

Children whose diets conformed fully to the allowances averaged 3½ to 4 cups of milk daily, at least 1 serving of the vitamin C-rich foods, 1 serving or slightly less of the green and yellow vegetables, 2 servings of meat or the equivalent in other protein-rich foods, and 5½ servings of cereal foods. The dietary classification was closely related to the intake of milk and vitamin C-rich fruits and vegetables.

This study has revealed some differences which should be considered in designing samples of children for nutritional studies. In Iowa, the major source of variation was among children within schools. In Kansas large differences were observed among schools within strata, but differences between strata were negligible. In Ohio large differences also were evident among schools within strata as well as differences among schools between strata.

Nutrition of 9-, 10- and 11-Year-Old Public School Children in Iowa, Kansas and Ohio

I. Dietary Findings

The purpose of this study was to determine the food habits and nutrient intake of 9,- 10- and 11-year-old children of three north central states—Iowa, Kansas and Ohio. Physical measurements were taken and hemoglobin concentrations determined for all of the children. Determinations of serum concentrations of ascorbic acid, carotenoids, vitamin A and alkaline phosphatase were made on portions of the total sample. Certain information was obtained regarding the homes and families.

This report deals with the nutritive value of the diets of 1,700 children. The diets were obtained from 3-day dietary records in 1948-51. Information about food habits and nutrient intake is essential in determining the need for nutritional improvement and in planning programs to bring about better health through improved nutrition.

An effort was made to apply scientific sampling techniques. Thus the data should be unbiased by factors such as family income, education, size of family and nationality background, except as they are reflected in the sampled population of the states. The observations may be expected to describe dietary conditions among the public school children in this age group in Iowa, Kansas and Ohio. In so far as these three states typify the rural and industrial areas of the North Central Region, the findings may be applicable to the public school children of the region.

THE SAMPLE

Statisticians in each of the three states cooperated in developing a design that would provide representative samples of schools according to centers of population, kind of school and whether or not a lunch was served at school. Schools were selected by random sampling in metropolitan areas, in consolidated school districts with populations of less than 50,000 and in rural districts in the open country. In Iowa the children in each school were listed alphabetically by age and sex and the names randomly selected. In Ohio and Kansas, if the enrollment in the fourth, fifth and sixth grades of the chosen schools was 60 or less, all of the children were studied. In larger schools the children were sampled as in Iowa.

In each state the number varied somewhat with the facilities for conducting the study and the other objectives chosen by the workers of the individual states. The Iowa sample included a large number of schools with a small number of children from each school; the Ohio and Kansas samples, relatively few schools but large numbers of children in each school. Table 1 summarizes the sampling and gives the number of children studied. A map and table showing the number and distribution of the schools were included in a previous publication (6).

DIETARY METHODS

The dietary data were obtained by the use of 3-day (Tuesday, Wednesday and Thursday) records, kept by the children with the assistance of parents and teachers. Trained dietitians gave instructions and supervision. The amounts of food were recorded in common household units of measure or in servings with sizes described as accurately as possible. The nutrient values were calculated for each of the 3 days by using, for the most part, the figures given in Handbook 8, Tables of Composition of Foods, Raw, Processed and Prepared (9), supplemented with Food Values of Portions Commonly Used (1) and with the U. S. Department of Agriculture Miscellaneous Publication No. 572 (7). Means and standard deviations were computed for average daily intakes, classified by age, sex, lunch participation and population group. Statistical analysis of the differences among states and among the geographical strata will be discussed, but since the differences among nutrients in the different strata within states were few, the means for the combined data of each state were first considered. A total of 5,100 daily records were studied for the 1,700 children—345 from Iowa, 645 from Kansas and 710 from Ohio. Boys numbered 818 and girls 882. The children were in the pre-pubertal period. They came from rural areas, towns and villages, and cities.

Although precautions were taken to be as accurate as possible, the inaccuracies of this dietary method are recognized. However, such methods have been shown to be reasonably accurate in revealing the nutrient intakes of groups (2). Although the distribution of the dietary records throughout the school year was not controlled, it included records for all the seasons within the school year. The findings, therefore, are believed to present a reasonable picture of the school-week

TABLE 1. STRUCTURE* AND SIZES OF SAMPLES OF 9-, 10- AND 11-YEAR-OLD SCHOOL CHILDREN IN IOWA, KANSAS AND OHIO, NUTRITION SURVEYS, 1948-51.

Population group†	Type of school	Lunch participation	Boys Iowa	Boys Kansas	Boys Ohio	Girls Iowa	Girls Kansas	Girls Ohio
			(No.)	(No.)	(No.)	(No.)	(No.)	(No.)
I Over 50,000	Elementary							
	Lunch schools	Yes	6	—	23	6	—	27
		No	6	—	51	7	—	40
		Sometimes	—	—	3	—	—	3
	Non-lunch schools		17	—	75	20	—	74
	Total		29	—	152	33	—	144
II Under 50,000	Elementary							
	Lunch schools	Yes	12	45	42	12	34	52
		No	12	53	61	14	66	55
		Sometimes	—	—	5	—	—	8
	Non-lunch schools		42	66	0	47	58	0
	Total		66	164	108	73	158	115
III Rural districts	Consolidated (Grades 1-12)							
	Lunch schools	Yes	50	52	42	58	73	38
		No	18	19	7	18	33	14
		Sometimes	—	—	6	—	—	1
	Non-lunch schools		—	65	40	—	81	43
	Total		68	136	95	76	187	96
Total by lunch participation		Yes	68	97	107	76	107	117
		No	95	203	234	106	238	226
		Sometimes	0	0	14	0	0	12
Grand total			163	300	355	182	345	355

* Structure here refers to the four stratifications imposed within the states, i. e., population group, type of school, lunch participation and sex.

† Population classifications for Ohio were city, village and county; the county children were those living in small towns of less than 3,000 population and in the open country.

dietary practices of public school children of the three states in a period of prosperity and of liberal food supplies.

THE MEAN DAILY NUTRIENT CONSUMPTION

DESCRIPTION BY STATE, SEX AND AGE

The estimated nutrient consumption is based on the means of values obtained by computing the average nutritive value of foods included in the 3-day records. The observations of this section are derived from data given in table 2. The mean nutrient intakes were compared with the recommended allowances (hereafter referred to as the allowances) of the National Research Council (1953) for the different age and sex groups. The age classification by year was determined by the child's last birthday.

The mean food-energy value of the diets of boys ranged from about 2,150 to 2,600 Calories daily and of the girls from 2,100 to 2,300. These values are in close agreement with the estimated allowances of 2,200 to 2,500 for boys and 2,200 to 2,300 for girls of 9, 10 and 11 years. The mean daily food-energy intakes of the sample children within each of the six age-sex groups from the three states were compared. They differed by less than 10 percent in all groups except the 9-year-old boys for whom the highest mean (2,478 Calories, Iowa) differed from the lowest (2,148 Calories, Kansas) by about 16 percent. Both boys and girls in Iowa had diets highest in food energy value, while Kansas boys and Ohio girls had the lowest. Boys of all ages had diets higher than those of girls in food-energy value; however, these sex-differences were less marked among the Kansas children than among the children of the other two states. Within the age range studied, yearly differences in food-energy value of diet were more evident with boys than with girls and with the Kansas children than with the Ohio and Iowa children.

The diets on the whole were well supplied with protein. The mean daily consumption of this nutrient ranged from 75 to 84 grams for boys and from 69 to 76 grams for girls; the allowances for children of these ages range from about 65 to 70 grams of protein. Mean daily protein intakes within each of the six age-sex groupings were fairly uniform among the state groups; in each grouping the lowest mean daily protein intake differed from the highest by approximately 6 to 8 percent. Relatively, protein means differed less among the state groups than did the means of the other nutrients. Protein intakes of boys were higher than those of girls and tended to increase with age more directly than did those of the girls. Iowa boys had significantly lower protein intakes in these comparisons. For children in Iowa, mean percentages of the total calories from protein were 12 to 13, for the children of the other states, 13 to 14.

For children 9 to 12, the allowances for calcium vary between 1,000 and 1,200 mg. daily. For the Iowa, Kansas and Ohio boys, mean daily intakes of calcium on school days generally were within this range; for girls the means hovered near the lower limit. When the mean intakes approximated

950 mg., as was the case with several of the groups of girls, many children must have had diets poorly supplied with calcium. Among the age-sex groups of the three states, the highest mean daily calcium intakes differed from the lowest by 4 to 14 percent. Throughout the groups, the Ohio children tended to have slightly higher intakes of calcium than had the children of the other two states.

Mean dietary iron values generally exceeded the allowances except for the 11-year-old Iowa girls, whose intakes averaged 10 mg. daily instead of the recommended 12 mg. The mean daily iron intakes varied from 11 to 14 mg. for boys and from 10 to 12 mg. for girls. The mean values varied among the states by as much as 21 percent in some age-sex groups. The diets of the Ohio children tended to rank highest in iron, and the Iowa children lowest.

The mean daily vitamin A values for boys ranged from approximately 6,500 to 9,500 I.U. and for girls from 5,200 to 8,000 I.U. Large positive margins existed between the observed mean values and the allowances. There were large differences among the means in the diets of the children of three states in specific age-sex groups. The difference between highest and lowest means reported for the 9-year-old boys of the three states was approximately 40 percent. The variation probably is due to intakes of a few specific foods particularly high in vitamin A value.

Mean daily thiamine intakes ranged from 1.2 to 1.8 mg. for boys and from 1.1 to 1.8 mg. for girls. Within the age-sex groups, the highest means differed from the lowest by 30 to 40 percent. The intakes were equal to or greater than the allowances. The values were higher for the Ohio than for the Kansas and Iowa children. The latter tended to have slightly lower intakes of this nutrient than had the children of the other two states.

The riboflavin means varied from 2.0 to 2.6 mg.

TABLE 2. NUTRITIVE VALUE* OF THE DAILY DIETS OF 9-, 10- AND 11-YEAR-OLD SCHOOL CHILDREN OF IOWA, KANSAS AND OHIO, NUTRITION SURVEYS, 1948-51.

Age (yrs.)	State	No.	Energy value (Cal.)		Protein (gm.)		Calcium (mg.)		Iron (mg.)		Vit. A value (I. U.)		Thiamine (mg.)		Riboflavin (mg.)		Niacin (mg.)		Ascorbic acid (mg.)	
			$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
BOYS																				
9	Iowa	53	2,478	487	75	18	1,156	325	12	3.0	9,523	8,801	1.2	0.26	2.1	0.81	13	4.0	87	35.9
	Kansas	84	2,148	599	76	25	1,053	401	12	3.6	6,670	4,135	1.3	0.42	2.0	0.69	12	5.2	75	55.2
	Ohio	100	2,332	497	80	20	1,176	429	13	5.1	7,931	5,452	1.8	1.25	2.5	1.42	16	10.8	85	56.0
10	Iowa	60	2,479	460	76	14	1,098	317	11	2.4	7,130	4,990	1.2	0.24	2.0	0.55	13	3.6	81	38.3
	Kansas	116	2,276	691	79	30	1,064	482	13	4.0	6,507	4,200	1.3	0.38	2.0	0.83	13	5.4	73	52.8
	Ohio	140	2,484	539	84	19	1,237	431	14	4.2	7,921	6,422	1.8	1.28	2.6	1.36	16	8.7	87	64.0
11	Iowa	50	2,574	407	79	17	1,135	279	12	8.0	7,619	5,665	1.2	0.24	2.1	0.53	13	4.6	89	36.1
	Kansas	100	2,341	650	81	29	1,111	541	13	4.1	6,693	5,611	1.3	0.40	2.1	0.94	14	7.1	62	38.0
	Ohio	108	2,441	620	82	21	1,157	370	14	6.7	7,040	7,533	1.8	1.43	2.4	1.22	16	10.5	81	53.0
GIRLS																				
9	Iowa	62	2,286	354	69	11	945	252	11	2.2	7,717	6,065	1.1	0.22	1.9	0.57	13	2.9	87	38.6
	Kansas	90	2,119	609	74	27	1,033	491	11	3.3	6,920	5,562	1.3	0.45	2.0	0.84	12	5.3	74	40.7
	Ohio	96	2,114	451	73	17	1,066	370	14	11.3	7,252	5,997	1.8	1.26	2.4	1.29	15	8.5	85	52.0
10	Iowa	62	2,328	428	69	14	985	274	11	2.2	7,847	8,888	1.2	0.27	1.9	0.65	12	3.4	91	43.0
	Kansas	120	2,154	533	74	25	962	387	12	3.8	7,255	4,853	1.2	0.31	1.9	0.71	13	5.3	76	56.5
	Ohio	151	2,092	462	72	17	1,055	404	12	4.7	6,402	4,750	1.6	1.15	2.2	1.21	14	8.2	75	43.0
11	Iowa	58	2,265	441	70	15	1,057	332	10	2.4	5,910	4,134	1.1	0.25	2.0	0.58	12	2.8	84	35.6
	Kansas	135	2,323	541	76	23	1,028	437	12	2.8	8,078	5,979	1.3	0.36	2.0	0.72	13	4.4	84	60.7
	Ohio	108	2,154	478	72	19	1,091	427	12	4.6	5,183	3,546	1.4	0.92	2.0	0.84	12	4.7	73	46.0

* Figures are means of the 3-day averages with standard deviations.

for boys and from 1.9 to 2.4 mg. for girls. These means had a smaller range than those of thiamine. The levels generally were far in excess of the allowances, and the diets of the Ohio children were slightly higher than those of the other two states in this respect.

The mean daily niacin intakes varied from 12 to 16 mg. for boys and 12 to 15 mg. for girls. Niacin intakes of children of the various age-sex groups in the three states tended to parallel the thiamine and riboflavin intakes.

Mean daily ascorbic acid intakes ranged from 62 mg. for 11-year-old Kansas boys to 89 mg. for Iowa boys of this age. For girls, the range was from 73 mg. for the 11-year-old Ohio girls to 91 mg. for the 10-year-old Iowa girls. For all but the 11-year-old Kansas boys the mean ascorbic acid consumption was close to or greater than the allowances. Compared with the Iowa and Ohio children, Kansas children (except the 10- and 11-year-old girls) had relatively lower intakes of this nutrient.

This description of the mean daily intake data of the 9-, 10-, and 11-year-old children shows that the dietaries as a group were usually well supplied with all nutrients but calcium, which, nevertheless, averaged about 80 percent of the allowances. Boys generally had higher levels of nutrient intake than girls and tended to have a larger mean consumption of food energy and protein at successive ages, whereas girls differed little in their nutrient consumption as shown by the 3-day records. Also with boys fairly uniform relationships were noted in the order, or pattern, of the means among the groups within the three states; there were similar intake trends among the data on food-energy value, protein, thiamine, riboflavin, iron and ascorbic acid. For instance, at each of the three ages the mean intake of thiamine by Iowa boys was the lowest, by Ohio boys the highest and by Kansas boys intermediate.

Changes in nutrient intake with age were less systematic for girls than for boys. At each age the means of the daily protein intake of Iowa girls were the smallest, those of the Kansas girls the largest and of the Ohio girls intermediate. From state-to-state and age-to-age the relative position of the mean intakes of protein was the most constant of all nutrients. Moreover, of all the nutrients the mean protein intakes for the children of the three state groups were most alike. Within any age-sex group they seldom varied more than 5 grams.

STATISTICAL EVALUATION OF DIFFERENCES AMONG STATE GROUPS

The summary presented thus far has given certain apparent facts for the data from the three states. To investigate these results further, certain statistical analyses of the data were conducted. Some preliminary detailed examinations of the sample were made for Iowa data alone to determine differences due to selection of days and differences between weighted and raw means.[1] In Iowa the simple arithmetic means for the combined ages were compared with means weighted according to the sampling design for food-energy value, protein, calcium, vitamin A value and ascorbic acid (table 3). Most of the differences were of the order of 1 to 2 percent of the weighted means, with the weighted mean usually about one standard error (of the weighted mean) below the arithmetic mean. For vitamin A value for girls, the difference was somewhat larger (about 4 percent), but this difference was considered of little consequence in view of the large sampling error as indicated by the standard error of the mean obtained for this nutrient. Therefore, the simple arithmetic averages were considered suitable estimates of average intakes for this sample of children, although they may overstate the averages by 1 to 2 percent.

Examination of the Iowa data also revealed that the averages of 12 items based on dietary records of Tuesday, Wednesday and Thursday were consistently about 1 percent higher than averages obtained from records of diets eaten the remaining 4 days of the week (table 4). The combined use of unweighted means and Tuesday, Wednesday and Thursday data only in Iowa appeared to overstate by 2 to 3 percent the actual values as obtained from weighted 7-day dietary records.

The precision of estimating the food-energy value, protein, calcium, vitamin A value and ascorbic acid in the mean daily diet was studied. The results are presented in table 5. The relative sampling errors indicate that precision is greatest in values for food-energy and protein, next best in ascorbic acid and calcium values, and least in the vitamin A value. This analysis agrees with the gross differences observed among the means of the data from the three states, where rela-

[1] Jebe and Wattier have prepared certain detailed analyses for the Iowa data that were not made for the other two states (3).

TABLE 3. SUMMARY OF SIMPLE ARITHMETIC MEAN AND WEIGHTED MEAN INTAKES FOR 9-, 10- AND 11-YEAR-OLD CHILDREN BY SEXES FOR FIVE NUTRIENTS, IOWA NUTRITION SURVEY, 1948-51.

Nutrient		Boys		Girls	
		Simple mean*	Weighted mean†	Simple mean*	Weighted mean†
Food energy value	Cal.	2,508	2,548	2,294	2,245
Protein	gm.	77	75	69	67
Calcium	mg.	1,128	1,099	944	984
Vitamin A value	I.U.	8,092	8,007	7,185	6,813
Ascorbic acid	mg.	85	82	87	85

*Computed by summing and averaging the 3-day average intakes for each child regardless of stratum or school within stratum from which child was chosen.
†Computed as a ratio estimate following the structure of the sampling design. Unbiased estimates of total intake for each nutrient and total number of boys and girls were prepared first. Then the weighted mean was obtained by taking the ratio of total intake to total children of each sex.

TABLE 4. COMPARISON OF 3-DAY AND 4-DAY AVERAGES* OF NUTRIENT INTAKES FOR 9-, 10- AND 11-YEAR-OLD CHILDREN BY AGE AND SEX, IOWA NUTRITION SURVEY, 1948-51.

Nutrient		Sex, age in years and time period											
		Boys†						Girls†					
		9 yr. (53)		10 yr. (60)		11 yr. (50)		9 yr. (62)		10 yr. (62)		11 yr. (58)	
		3-day	4-day	3-day	4-day	3-day	4-day	3-day	4-day	3-day	4-day	3-day	4-day
Food energy value	Cal.	2,478	2,399	2,479	2,370	2,574	2,646	2,286	2,279	2,328	2,244	2,265	2,260
Protein	gm.	75	73	76	72	79	79	69	71	69	67	70	68
Fat	gm.	120	115	123	112	123	126	111	109	110	105	110	108
Carbohydrate	mg.	294	285	295	274	300	318	269	264	290	269	261	266
Calcium	mg.	1,156	1,046	1,098	998	1,135	1,123	945	964	985	899	1,057	968
Phosphorus	mg.	1,421	1,311	1,375	1,314	1,438	1,424	1,244	1,262	1,272	1,198	1,290	1,232
Iron	mg.	11.6	11.1	11.2	11.2	11.6	11.6	10.9	10.4	11.3	10.6	10.2	10.0
Vitamin A	I.U.	9,523	7,605	7,130	7,849	7,619	7,650	7,717	6,421	7,847	8,132	5,910	6,869
Thiamine	mg.	1.17	1.12	1.16	1.11	1.22	1.22	1.14	1.10	1.15	1.04	1.11	1.09
Riboflavin	mg.	2.17	1.94	2.01	1.98	2.07	2.12	1.85	1.80	1.87	1.78	1.96	1.84
Niacin	mg.	13.1	12.6	13.0	13.4	13.4	13.4	12.6	12.2	12.3	11.8	11.6	12.1
Ascorbic acid	mg.	87	82	81	74	89	82	87	78	91	82	84	77

*The 3-day averages for each nutrient for each child, which have been summed and again averaged to form the mean intakes listed in this table, are for Tuesday, Wednesday and Thursday. Correspondingly, the 4-day mean intakes are based upon the intakes for the remaining days of the week—Friday, Saturday, Sunday and Monday.

†Figures in parentheses indicate number of boys and girls at each age.

tive differences were smallest for protein and food-energy value, next smallest in calcium and largest among the vitamins. If the actual measurements of the intakes of the children were unbiased, then it appears that the Iowa sample (the smallest of the three samples) was adequate in size and that satisfactory approximate 95 percent confidence intervals for state average intakes may be constructed by setting up the intervals—the weighted mean ± 2 standard errors.

Statistical analysis for comparing the means from the data of the three states may be approached in several ways. Ideally, one would like a suitable analysis of variance for this purpose. The structure of the sampling scheme as exhibited partially in table 1 indicates the difficulty of the problem: lack of balance in numbers and non-uniformity in numbers of strata plus rather burdensome calculations. On the other hand, a simple approach can be made by considering the ranking of the state age-sex means for each nutrient. Each nutrient presents six such groupings. If we consider it equally likely that each state ranks highest for a given nutrient, then the expansion of the multinominal $(\frac{1}{3} + \frac{1}{3} + \frac{1}{3})^6$ would give the probabilities of various rankings. For example, if any one state ranked highest in all six groupings, this should occur only with probability 3/729 under the specified hypothesis. Similarly, if only one sex is considered the chance is 3/27. The first of these values reasonably may be judged significant and, perhaps, in some circumstances the second. For example, if we form the age-sex group rankings for the nutrients from the data given in table 2, we observe that the calcium intakes of Ohio boys and girls and protein intakes of Kansas girls exhibit ranks of the kind just described. Hence, on the basis of such small probabilities, we conclude that the Ohio boys and girls have higher calcium intakes than the groups sampled in the other two states. A similar conclusion is reached for the protein intakes of the Kansas girls. Other comparisons noted in the summary generally follow this criterion.

An examination of the standard deviations (see table 2) from which approximate standard errors of the means may be computed, raises some question about the consistency of some of the ranks just noted. Somewhat more detailed analyses were made with analysis of various ranks (8). The procedure ignored the stratification within states but used school averages, ranked from highest to lowest. Selected results on ascorbic acid intakes are presented in table 6; tables 6a and 6b present illustrative data used in preparing table 6.

TABLE 5. WEIGHTED MEAN INTAKES OF 9-, 10- AND 11-YEAR-OLD CHILDREN FOR FIVE NUTRIENTS AND MEASURES OF THEIR RELIABILITY, IOWA NUTRITION SURVEY, 1948-51.

Nutrient		Boys			Girls		
		Weighted mean	Standard error of mean	RSE* in percent	Weighted mean	Standard error of mean	RSE* in percent
Food energy value	Cal.	2,548	41	1.6	2,245	48	2.1
Protein	gm.	74.9	1.6	2.1	67.2	1.5	2.2
Calcium	mg.	1,099	49	4.4	984	66	6.7
Vitamin A	I.U.	8,007	668	8.3	6,813	515	7.5
Ascorbic acid	mg.	82.4	3.3	4.0	84.6	4.5	5.3

*Relative sampling error expressed in percent, e. g., (48/2,245) × 100 = 2.1 percent for caloric intake of Iowa girls aged 9-, 10- and 11 years.

TABLE 6a. MEAN ASCORBIC ACID INTAKE FOR BOYS BY INDIVIDUAL SCHOOL WITH RANK ASSIGNED THE SCHOOL FOR COMPUTING ANALYSIS OF VARIANCE OF RANKS. NUTRITION SURVEYS IOWA, KANSAS AND OHIO, 1948-51.

School number	Iden. number	Mean Asc. acid intake	Rank†	School number	Iden. number	Mean Asc. acid intake	Rank†	School number	Iden. number	Mean Asc. acid intake	Rank†
1	20	66.5*	26	30	46	43.0	5	58	5	47.5	8
2	24	85.0	51.5	31	47	77.7	41	59	6	68.6	28
3	25	77.0	39	32	48	78.0	43	60	7	46.2	6
4	18	55.3	16	33	50	71.5	32	61	8	54.6	13
5	19	97.5	67	34	51	129.0	81	62	9	72.7	35
6	21	95.5	63	35	54	137.5	84	63	10	49.6	9
7	22	40.5	2	36	56	96.0	64	64	11	42.8	4
8	23	79.5	46	37	60	93.8	60	65	20	116.7	78
9	26	83.0	49.5	38	3	89.7	57.5	66	21	72.3	34
10	29	106.0	74	39	4	69.7	30	67	22	67.8	27
11	35	41.0	3	40	5	65.8	25	68	23	58.7	18
12	30	77.8	42	41	9	94.3	61	69	24	71.8	33
13	37	76.2	36	42	17	98.5	69	70	53	89.7	57.5
14	39	77.0	39	43	1	102.1	72	71	1	77‡	39
15	40	96.8	66	44	2	78.6	45	72	2	80	47
16	42	76.8	37	45	6	55.8	17	73	3	87	55
17	49	78.2	44	46	7	85.8	54	74	7	70	31
18	27	96.5	65	47	8	137.0	83	75	8	63	23
19	28	110.5	75.5	48	10	85.7	53	76	9	93	59
20	31	61.0	21	49	11	99.8	71	77	10	85	51.5
21	32	95.0	62	50	12	87.7	56	78	11	40	1
22	33	110.5	75.5	51	13	116.2	77	79	12	47	7
23	34	54.0	12	52	14	55.0	14.5	80	13	104	73
24	36	52.7	10	53	15	122.0	80	81	14	118	79
25	38	81.5	48	54	16	129.7	82	82	15	98	68
26	41	60.5	20	55	2	99.4	70	83	16	83	49.5
27	43	53.3	11	56	3	63.0	23	84	17	63	23
28	44	55.0	14.5	57	4	59.2	19	85	18	149	85
29	45	69.0	29								

*Measured in mg. This is an average for all boys sampled in the school. In some cases the figure represents lunch and no-lunch groups combined; in other cases, either lunch or no-lunch students alone, depending on school lunch status. Schools 1-54 were in Iowa; 55-70, in Kansas; and 71-85, in Ohio.

†Assignment of ranks for tied means was handled as described by Wallis and Kruskal (8).

‡Mean ascorbic acid values from Ohio were computed to the nearest whole number.

TABLE 6b. MEAN ASCORBIC ACID INTAKE FOR GIRLS BY INDIVIDUAL SCHOOL WITH RANK ASSIGNED THE SCHOOL FOR COMPUTING ANALYSIS OF VARIANCE OF RANKS. NUTRITION SURVEYS IOWA, KANSAS AND OHIO, 1948-51.

School number	Iden. number	Mean Asc. acid intake	Rank†	School number	Iden. number	Mean Asc. acid intake	Rank†	School number	Iden. number	Mean Asc. acid intake	Rank†
1	20	90.8*	57.5	30	46	63.0	18	58	5	44.9	5
2	24	90.8	57.5	31	47	51.0	8	59	6	73.7	30
3	25	100.2	71	32	48	65.5	23	60	7	52.2	10
4	18	77.7	40.5	33	50	99.3	68	61	8	59.2	15
5	19	50.5	7	34	51	52.0	9	62	9	80.4	46
6	21	99.7	69	35	54	106.5	73	63	10	56.3	12
7	22	38.0	3	36	56	40.5	4	64	11	76.5	39
8	23	56.5	13.5	37	60	56.5	13.5	65	20	109.9	75
9	26	85.5	52	38	3	72.3	28	66	21	96.4	64
10	29	34.5	1	39	4	79.7	44	67	22	91.6	61
11	35	108.0	74	40	5	103.0	72	68	23	67.2	26
12	30	81.6	48	41	9	87.7	55	69	24	79.9	45
13	37	75.2	36	42	17	35.0	2	70	53	80.8	47
14	39	127.5	81	43	1	133.7	83	71	1	64‡	20
15	40	79.6	43	44	2	74.9	33	72	2	83	50
16	42	73.5	29	45	6	82.2	49	73	3	66	24
17	49	77.7	40.5	46	7	70.2	27	74	7	55	11
18	27	74.0	31.5	47	8	75.0	34.5	75	8	93	63
19	28	96.7	65	48	10	91.5	60	76	9	85	51
20	31	87.0	54	49	11	126.0	80	77	10	74	31.5
21	32	112.0	76.5	50	12	88.0	56	78	11	49	6
22	33	75.0	34.5	51	13	161.8	85	79	12	62	16.5
23	34	75.5	38	52	14	64.0	20	80	13	91	59
24	36	64.3	22	53	15	120.0	78	81	14	86	53
25	38	64.0	20	54	16	133.3	82	82	15	98	67
26	41	75.3	37	55	2	100.1	70	83	16	112	76.5
27	43	92.0	62	56	3	66.3	25	84	17	62	16.5
28	44	134.0	84	57	4	97.2	66	85	18	78	42
29	45	121.5	79								

*Measured in mg. This is an average for all girls sampled in the school. In some cases the figure represents lunch and no-lunch groups combined; in other cases, either lunch or no-lunch students alone, depending on the school lunch status. Schools 1-54 were in Iowa; 55-70, in Kansas; and 71-85, in Ohio.

†Assignment of ranks for tied means was handled as described by Wallis and Kruskal (8).

‡Mean ascorbic acid values from Ohio were computed to the nearest whole number.

TABLE 6. ANALYSIS OF ASCORBIC ACID INTAKES OF 9-, 10- AND 11-YEAR-OLD SCHOOL CHILDREN SELECTED FROM SCHOOLS CHOSEN FROM SPECIFIED STRATA, NUTRITION SURVEYS, 1948-51.

Sex	Iowa	Kansas	Ohio
Boys			
Mean intake (mg.)	85.4	68.4	84.0*
Mean rank, $\bar{r}$	46.3	28.9	46.1†
Test criterion, H = 6.43‡			
Girls			
Mean intake (mg.)	87.4	78.3	77.0*
Mean rank, $\bar{r}$	45.0	39.8	39.1†
Test criterion, H = 1.91‡			

*These mean intakes are the simple arithmetic average intakes of ascorbic acid within each of the three states regardless of stratum or school. For Iowa the corresponding weighted mean intakes for boys and girls are 82.4 and 84.6 (see table 3).

†These mean ranks were obtained by ranking the school means for each sex separately over the three states and then averaging the school ranks within each state (see tables 6a and 6b).

‡The method of analysis of variance for ranks (8) yields a statistic designated as H which corresponds to the Snedecor F ratio of the usual analysis of variance. H, for the above cases, has a sampling distribution that can be approximated by the X^2 distribution. The probability $(X^2_2 \geq 5.99) = 0.05$. Hence the value H = 6.43 is judged significant.

For the girls, with the three ages combined, there were no state differences for the five items (food energy value, protein, calcium, vitamin A value and ascorbic acid) examined which could not be attributed to sampling variation. For boys, also with three ages combined, differences were significant in the means for food-energy value, protein and ascorbic acid but not for calcium and vitamin A value. In each of these first three items, the values for Kansas boys were lowest and for Ohio boys generally highest. These differences were, in the main, apparent from a gross view of the means.

Statistical analysis of variation within the states revealed differences which might be of considerable significance in designing future samples. In Iowa the major sources of variation were among children within schools. In Kansas there were large differences among schools within strata, but differences between strata were negligible. In Ohio, large differences also were evident among schools within strata as well as differences be-between strata. Such differences should be considered in designing future nutritional studies of children within these and possibly other states. Examples of these within-state analyses are presented in table 7.

The marked differences among strata in the Ohio data were subjected to further statistical analysis for the following items by the Statistics Laboratory of The Ohio State University: mean food-energy value, and the mean daily intake of protein, calcium, ascorbic acid and vitamin A. A four-way analysis of variance was made for each of these nutrients. The classifications used were age, sex, geographical stratum and school-lunch participation. City children exceeded village children in mean daily food-energy value of the diets, and in terms of adjusted means the latter exceeded the county children. Village children of Ohio had more dietary protein and calcium than city children, who in turn had more than county children. On the other hand, the village children were shown to have smaller amounts of vitamin A than had the city or county children. In these comparisons the county children, those living in small towns of less than 3,000 population and in the open country, generally had diets of lower nutrient content than had the village and city children in larger villages and cities, although for ascorbic acid the lower value was not adjudged significant.

PERCENTAGE DISTRIBUTION OF CHILDREN ACCORDING TO NUTRIENT CONTENT OF DIETS

Because the distribution of some nutrients in the diets might be skewed, the 25th, 50th and 75th percentiles were calculated by sex for each state sample[2] (table 8).

In regard to food-energy value and to most nutrients, the 25th percentiles were lower for the Kansas than for the Ohio and Iowa children. Mean daily calcium intakes of 800 mg. or less were reported for 25 percent of all girls and of Kansas boys. Notwithstanding the high means

[2] The following discussion is based on the observed sample percentages in each state, i. e., the point estimates of unknown population percentages. The sampling errors of these estimates have not been investigated in detail. For example, the standard error of a quartile figure, p = 0.25 or p = 0.75, for either sex in Iowa is roughly about 0.03 or 3 percent. More exactly, what is desired is an interval defined by two sample values or order statistics, x_r and x_s, such that 95 percent confidence may be attached to this interval in locating the population quartile (4).

TABLE 7. TYPICAL ANALYSES OF VARIANCE FROM OHIO, KANSAS AND IOWA, SELECTED TO ILLUSTRATE THE TYPES OF VARIATION OBSERVED WITHIN STATES, NUTRITION SURVEYS, 1948-51.

Source of variation	Degrees of freedom	Sum of squares	Mean square
Iowa—Analysis of variance of protein intakes of 9-, 10- and 11-year-old boys			
Strata	7	1,587	227
Between schools within strata	55	13,074	238
Boys in schools in strata	100	28,005	280
Total	162	42,666	———
Kansas—Analysis of Variance of food energy intakes of 9-, 10- and 11-year-old boys			
Strata	3	1,117,300	372,400
Between schools within strata	12	21,967,400	1,830,600
Boys in schools in strata	208	74,066,500	356,100
Total	223	97,151,200	———
Ohio—Analysis of variance of protein intakes of 9-, 10- and 11-year-old boys			
Strata	2	8,433	4,217
Between schools within strata	12	12,597	1,050
Boys in schools in strata	340	120,455	354
Total	354	141,435	———

TABLE 8. QUARTILES OF THE FREQUENCY DISTRIBUTIONS OF MEAN DAILY NUTRIENT INTAKES OF 9-, 10- AND 11-YEAR-OLD CHILDREN.

Nutrient		Boys Percentile*			Girls Percentile*		
		Q_1	Q_2	Q_3	Q_1	Q_2	Q_3
Food energy value (Cal.)	Iowa	2,238	2,506	2,795	2,005	2,327	2,565
	Kansas	1,764	2,200	2,666	1,778	2,168	2,557
	Ohio	2,044	2,421	2,760	1,818	2,092	2,390
Protein (gm.)	Iowa	67	78	86	61	69	79
	Kansas	58	76	91	53	72	89
	Ohio	69	82	95	61	73	82
Calcium (mg.)	Iowa	927	1,147	1,314	773	1,010	1,184
	Kansas	696	1,027	1,322	711	961	1,275
	Ohio	941	1,209	1,426	803	1,005	1,279
Iron (mg.)	Iowa	9.9	11.3	13.1	9.1	10.8	12.2
	Kansas	9.7	11.2	15.2	9.7	12.1	14.1
	Ohio	10.9	13.2	15.1	9.6	11.5	13.6
Vitamin A (I.U.)	Iowa	3,848	5,750	11,250	3,707	4,973	8,312
	Kansas	3,460	5,187	8,687	3,537	5,715	9,600
	Ohio	3,525	5,553	9,661	2,967	4,412	7,802
Thiamine (mg.)	Iowa	1.03	1.17	1.34	0.96	1.12	1.33
	Kansas	1.02	1.28	1.56	1.02	1.21	1.46
	Ohio	1.19	1.47	1.79	1.02	1.25	1.58
Riboflavin (mg.)	Iowa	1.75	2.05	2.35	1.52	1.81	2.14
	Kansas	1.43	1.90	2.50	1.41	1.82	2.38
	Ohio	1.81	2.24	2.83	1.57	1.97	2.43
Niacin (mg.)	Iowa	11.0	13.0	15.0	10.0	12.0	14.0
	Kansas	8.9	12.1	16.1	9.1	11.9	15.7
	Ohio	11.1	13.6	16.9	9.4	11.6	14.6
Ascorbic acid (mg.)	Iowa	59	82	107	58	81	113
	Kansas	38	58	80	32	67	99
	Ohio	43	75	113	45	68	100

*The median is Q_2; 25 percent had intakes less than Q_1, the first quartile, and 25 percent greater than Q_3.

noted among the vitamin A values, 25 percent of the children in each state-sex group had relatively low values—2,950 to 3,850 I.U. Similarly, 25 percent of both boys and girls in each state had ascorbic acid intakes below 60 mg. The percentiles, as well as the means, revealed generally satisfactory levels of protein intake; only for the Kansas girls was the 25th percentile appreciably below 60 grams.

In table 9 the observed mean intakes of the children have been compared with figures approximating 67 percent of the allowances. On the whole, more of the Kansas than of the Iowa or Ohio boys had nutrients below this level of intake; also, except in iron, vitamin A value and thiamine, more of the Kansas girls than of the Iowa or Ohio girls had diets in this category. Iowa generally had the fewest children below this level of nutrient intake. The comparison indicates that the greatest nutrient inadequacies,

TABLE 9. PERCENTAGES OF CHILDREN WITH MEAN DAILY NUTRIENT CONTENT OF DIET BELOW 67 PERCENT OF THE ALLOWANCES.*

Nutrient	Boys				Girls			
	67 percent of allowances* (approximate)	Iowa percent	Kansas percent	Ohio percent	67 percent of allowances (approximate)	Iowa percent	Kansas percent	Ohio percent
Food energy value	1,600 Cal.	2.5	14.3	5.6	1,500 Cal.	4.4	12.5	11.4
Protein	45 gm.	3.1	7.0	2.6	45 gm.	2.2	7.8	4.7
Calcium	800 mg.	12.9	31.3	16.4	800 mg.	29.3	33.3	24.8
Iron	8 mg.	6.7	10.3	5.6	8 mg.	9.9	7.2	10.5
Vitamin A value	3,000 I.U.	10.4	17.3	17.6	3,000 I.U.	13.8	13.3	25.9
Thiamine	0.8 mg.	5.5	7.7	5.0	0.8 mg.	6.6	4.6	7.0
Riboflavin	1.1 mg.	3.7	10.3	5.0	1.1 mg.	5.5	10.7	7.0
Niacin	8 mg.	5.5	17.7	5.9	8 mg.	6.1	13.6	9.3
Ascorbic acid	50 mg.	16.6	41.0	33.4	50 mg.	17.7	34.5	30.6
Number of children		163	300	341		181	345	343

*Estimated from the Recommended Dietary Allowances, Revised 1953 (6).

as measured by a failure to consume 67 percent of the allowances, were in ascorbic acid, calcium and vitamin A value (table 9). As many as one-third of the Kansas boys and girls had diets with less than 67 percent of the allowances for calcium, and approximately one-fourth of Ohio and Iowa girls had calcium intakes similarly low. About one-third of the Ohio and Kansas boys and girls had less than 67 percent of the allowances of ascorbic acid in their mean daily diets. Ten percent or less of the children in the three states had diets below this intake level in protein, iron, thiamine and riboflavin. Although the mean daily intakes of all nutrients but calcium appeared to be liberal, it is important to note that for each group but the Iowa boys, 30 to 40 percent of the children had diets with less than 67 percent of the allowances of one or more of the nutrients, usually calcium and/or ascorbic acid. Except for the Kansas children and the Ohio girls, less than 10 percent of the children had diets with food-energy value below the allowances for their respective ages; in Kansas these percentages were only 14 for the boys and 12 for the girls.

NUTRITIVE VALUE OF DIETS IN RELATION TO LUNCH PARTICIPATION

In view of the great expansion of school lunch programs in Iowa, Kansas and Ohio since the passage of the National School Lunch Act in 1946, one objective of this study was to examine the influence of the school lunch on the diets of the children. Several studies have been made of the lunch itself, but few have tried to determine differences in the total day's diets resulting from the lunch. Unless the total dietary of the child is improved, the lunch cannot be expected to improve the nutritional status of the child.

In each state means and frequency distributions were made of the average 3-day nutrient intakes of the children by age-sex groupings. Analysis of variance (table 7) showed few nutrient differences among any of the strata, including the lunch and non-lunch, in the states except in Ohio. Further statistical analyses made of the Ohio data by the Statistics Laboratory of The Ohio State University revealed no significant differences between the mean daily nutrient intakes of the lunch and non-lunch children in that state.

Evidence of the advantages gained by the school lunch might be most easily recognized among children whose diets are not well supplied with nutrients. If the lunch program can be shown to reduce the number of children obtaining low nutrient intakes, a considerable advantage will have been gained by it. Accordingly, an analysis was made of the percentages of the lunch and non-lunch participants whose diets contained less than 67 percent of the allowances of the various nutrients (table 10). For the boys in each state, with only two exceptions (calcium for the Iowa and vitamin A value for the Ohio boys) fewer, percentagewise, of the lunch than of the non-lunch groups had diets in this low classification. Through the lunch, the proportion of boys with low nutrient intakes appears to have been reduced. Moreover, the boys gained advantages of the lunch in the nutrients most often deficient according to dietary studies; i.e., in ascorbic acid, calcium and vitamin A value. The differences between the lunch and non-lunch groups were more evident among the Kansas and the Ohio boys than among the Iowa boys.

Differences between the lunch and non-lunch participants with diets with one or more nutrients below 67 percent of the allowances were less marked among the girls than among the boys, but in a majority of items, in each of the three states, there were fewer of the "lunch" girls than the

TABLE 10. PERCENTAGES OF LUNCH AND NON-LUNCH PARTICIPATING CHILDREN WITH MEAN DAILY NUTRIENT CONTENT OF DIETS BELOW 67 PERCENT OF THE ALLOWANCES.*

Nutrient	Boys						Girls					
	Iowa		Kansas		Ohio		Iowa		Kansas		Ohio	
	A	B†	A	B	A	B	A	B	A	B	A	B
Food energy value	1.5	3.1	8.2	17.2	0.9	7.7	5.1	3.9	11.2	13.0	6.8	13.7
Protein	1.5	4.1	2.1	9.4	0.0	3.8	1.3	2.9	2.8	10.1	3.4	5.3
Calcium	13.6	12.4	18.6	37.4	14.0	17.5	34.6	25.2	32.7	33.6	23.9	25.2
Iron	3.0	9.3	4.1	13.3	3.7	6.4	7.7	11.7	1.9	9.7	8.5	11.5
Vitamin A value	4.5	14.4	6.2	22.7	17.8	17.5	9.0	17.5	2.8	18.1	26.5	25.7
Thiamine	3.0	7.2	4.1	9.4	1.9	6.4	6.4	6.8	2.8	5.5	6.8	7.1
Riboflavin	3.0	4.1	1.0	14.8	0.9	6.8	5.1	5.8	11.2	10.5	5.1	8.0
Niacin	4.5	6.2	11.3	20.7	1.9	7.7	6.4	5.8	9.3	15.5	7.7	10.2
Ascorbic acid	12.1	19.6	26.8	47.8	29.0	31.2	7.7	25.2	27.1	37.8	28.2	31.9
Number of children	66	97	97	203	107	234	78	103	107	238	117	226

*Allowances, refer table 9.

†A, Children participating in school lunch program.

B, Children not participating in the school lunch program.

"non-lunch" girls with diets in this low classification. The percentages of girls with low ascorbic acid and iron intakes were considerably reduced among the lunch participants. The ratings in vitamin A value of the diets of the Kansas and Iowa girls were better in the lunch than the non-lunch group. The frequency of low calcium intakes among the girls was unaffected by the lunch; the proportion with low intakes varied between one-fourth and one-third, regardless of lunch practices. This is surprising in view of the emphasis given to the use of milk in the school lunch. Apparently serving milk routinely at school did not ensure acceptance or habitual use of milk in amounts sufficient to provide adequate calcium in the diet.

This analysis indicates that the school lunch, or conditions associated with it, did reduce the number of children whose diets were at a low nutritive level. Further study is needed to learn whether there is a real difference between boys and girls in their acceptance in the school lunch of important foods, notably milk, and to discover why the school lunch program is not equally as effective in improving nutrient consumption of girls as of boys. Efforts need to be directed particularly toward the use of the school lunch and its accompanying educational programs in bringing about further improvements in the quality of the diets of the 9-, 10- and 11-year-old children of these states in ascorbic acid, calcium and vitamin A value.

FOOD GROUPS IN THE DIETS OF SCHOOL CHILDREN OF IOWA, KANSAS AND OHIO

The 3-day records were studied to determine the average number of servings of certain foods. The classifications used were as follows:

I. Leafy, green and yellow vegetables
II. Vitamin C-rich fruits and vegetables
III. Other fruits and vegetables
IV. Milk and related products
V. Meat, poultry, fish, eggs and legumes
VI. Cereal foods as breads and breakfast foods.

The unit in which food is commonly eaten was considered as a serving when applicable; e.g., an apple, an orange, a slice of bread. One-half cup was the measure of a serving of such foods as cereals and cooked vegetables and fruits. One-fourth cup was used as a serving for raw vegetables. One cup comprised the size of serving used for milk. Equivalents of 1 cup of milk included 30 grams of cheddar cheese, 1 cup of cottage cheese and 1 cup or 2 dips of ice cream. Counted as 1 serving of protein-rich food in Group V were 2 to 3 ounces of meat, 2 eggs, 1 cup of cooked dried legumes or 4 tablespoons of peanut butter.

THE DIETARY PATTERN AS REGARDS CERTAIN FOOD GROUPS

Table 11 shows the average number of servings of the six groups studied for the children of each state. Data were obtained for each of the age-sex groups, but in this age range of 9 to 11 inclusive, no differences were observed. Therefore, the information for the boys and girls was pooled irrespective of age.

TABLE 11. AVERAGE DAILY NUMBER OF SERVINGS OF FOODS FROM CERTAIN FOOD GROUPS* IN THE 3-DAY DIETS.

	No. of children	I	II	III	IV	V	VI
		(Average number of servings daily)					
Boys							
Iowa	162	0.5	0.8	2.6	2.9	1.6	4.4
Kansas	300	0.7	0.7	2.0	2.7	2.1	4.9
Ohio	355	0.8	1.0	3.8	3.1	2.0	5.3
Girls							
Iowa	179	0.5	0.8	2.5	2.5	1.5	3.8
Kansas	345	0.8	0.8	2.1	2.6	2.0	4.2
Ohio	355	0.7	1.0	3.7	2.9	1.8	4.4

*Food group designations:
I. Leafy, green and yellow vegetables
II. Vitamin C-rich fruits and vegetables
III. Other fruits and vegetables
IV. Milk and related products
V. Meat, poultry, fish, eggs and legumes
VI. Cereal foods.

These children averaged slightly more than ½ serving daily of the green, leafy and yellow vegetables, 1 serving or slightly less, of vitamin C-rich fruits and vegetables, and from 2 to 4 servings of other fruits and vegetables. The Ohio children ranked highest in use of fruits and vegetables. Their total average was over 5 servings of these foods a day. Iowa children had diets conspicuously low in the green, leafy and yellow vegetables.

Boys of the three states averaged 2.7 to 3.1 cups of milk daily; girls, from 2.5 to 2.9. In each state, girls had less milk than boys. Among the children of the three states, both the Ohio boys and girls ranked highest in milk consumption. The average number of servings of the protein-rich foods varied from 1.5 to 2.1 daily and was highest for the Kansas and lowest for the Iowa boys and girls.

The cereal consumption, which included breads, muffins, etc., as well as breakfast cereal, ranged from 3.8 to 5.3 servings daily. The mean intakes of this food increased at successive ages from 9 through 11 and was higher at each age for boys than for girls. In fact, throughout the food groups studied, boys tended to have more than girls of most food groups, except the green, leafy and yellow vegetables and the vitamin C-rich fruits and vegetables.

Nutrient consumption may often be implied from the use of food groups. Accordingly, in this study Ohio children tended to have the largest number of servings of most of the food groups; they also tended to have the highest mean daily intakes of calcium, iron, thiamine, riboflavin and niacin and ranked lowest among the children of the three states only in the food energy value of the girls' diets.

The Kansas girls, who had the largest number of servings of meat, poultry, fish, eggs and legumes, ranked first among the girls in protein intake. The diets of Iowa children were lowest in protein, iron and thiamine, as might be expected since their diets also were lowest in cereals and in meat and related foods.

Trends in calcium intake closely followed trends in number of servings of milk. Trends in vitamin A and ascorbic acid consumption corresponded less consistently with the use of fruits and vegetables usually associated with these nutrients. Actually the diets of the Iowa children ranked highest in most age-sex groups in these nutrients though their intakes of the green, leafy and yellow vegetables were lowest. Intakes of vitamin A and ascorbic acid were variable. This discrepancy between rating with respect to vitamin C and vitamin A value of the diet and the apparent intake of corresponding food groups suggests caution in the use of food groups in the classification of diets.

With the exception of the vitamin A value and ascorbic acid content of the diet, the relative nutritive value of the diets of school children may be apparent from the representation of various food groups in the diets.

FOOD GROUPS IN THE DIET OF THE CHILDREN WITH AND WITHOUT THE SCHOOL LUNCH

Table 12 shows the use of the food groups in the daily diets of children participating and not participating in school lunch programs. There were three major differences between the diets of the lunch and the non-lunch children. First, for all but Kansas girls, the children with the school lunch averaged more of the vitamin C-rich foods in terms of servings per day. Second, for boys and girls of Iowa and Kansas, those with the school lunch averaged more servings per day of the leafy, green and yellow vegetables than did those without the school lunch. Third, in each age-sex group the non-lunch had more than the lunch children of the foods in the cereal group. The milk intake of the non-lunch girls tended to be higher than that of the girls who participated in the school lunch. Evidently the milk given at school resulted in an increase of the total intake of milk only by boys in Kansas and Ohio.

From the food usage by the children with and without lunch, little difference might be expected in the nutritive value of the diets except in vitamin C and possibly in vitamin A. As has been pointed out, no significant differences were noted among the mean nutrient intakes, although usually fewer of the lunch than of the non-lunch children had mean daily intakes of ascorbic acid and vitamin A less than 67 percent of the allowances. The mean daily intakes of the lunch and non-lunch children in calcium and in ascorbic acid are shown in table 13. As indicated by the milk consumption, girls without the school lunch tended to have higher daily calcium intakes than those who had the school lunch. In 11 of 18 comparisons, children with the school lunch had higher mean daily intakes of ascorbic acid than children without the school lunch. Again there is evidence that a strong educational program is needed if the school lunch is to improve the food habits of the children. Further study is needed of the interrelationship between the school meals and the total day's diet.

FOOD GROUP USAGE AND ADEQUACY OF DIETS

The diets were classified into three groups: (1) those in which the mean daily intakes of all nutrients were 100 percent or more of the recommended allowances; (2) those with some nutrients less than 100 percent but none less than 67 percent of the allowances; and (3) those with at least one nutrient less than 67 percent of the allowances. Means were computed for the average daily number of servings from the six food groups (see table 14).

The percentage of boys with diets conforming fully to the allowances were 10, 21 and 25 for the Kansas, Iowa and Ohio boys, respectively. A lower percentage of the girls had diets in the highest classification. These percentages were 8, 9 and 13 for the Kansas, Ohio and Iowa girls in the order listed. In three of the six state-sex

TABLE 12. AVERAGE DAILY NUMBER OF SERVINGS OF FOODS FROM CERTAIN FOOD GROUPS* IN 3-DAY DIETS CLASSIFIED ACCORDING TO SCHOOL LUNCH PARTICIPATION.

	School lunch participation	Number of children	I	II	III	IV	V	VI
			(Average number of servings daily)					
Boys								
Iowa	With lunch	65	0.7	0.9	2.6	2.7	1.7	4.3
	Without lunch	97	0.4	0.7	2.6	3.0	1.6	4.4
Kansas	With lunch	97	0.9	0.8	2.1	2.9	2.1	4.3
	Without lunch	203	0.5	0.6	1.9	2.6	2.1	5.1
Ohio	With lunch	107	0.7	1.1	3.7	3.3	2.0	5.0
	Without lunch	234	0.9	1.0	4.0	3.1	2.1	5.5
Girls								
Iowa	With lunch	77	0.7	0.9	2.5	2.4	1.6	3.6
	Without lunch	102	0.4	0.7	2.5	2.7	1.4	4.0
Kansas	With lunch	107	1.0	0.8	2.3	2.5	2.1	3.9
	Without lunch	238	0.7	0.8	2.0	2.6	1.9	4.4
Ohio	With lunch	117	0.7	1.1	3.7	2.8	1.8	4.1
	Without lunch	226	0.8	1.0	3.7	2.9	1.8	4.6

*For food group designations see table 11.

TABLE 13. MEAN DAILY CALCIUM AND ASCORBIC ACID INTAKES OF CHILDREN WITH AND WITHOUT THE SCHOOL LUNCH.

Age in years		Boys						Girls					
		Calcium			Ascorbic acid			Calcium			Ascorbic acid		
		Iowa	Kansas	Ohio	Iowa	Kansas	Ohio	Iowa	Kansas	Ohio	Iowa	Kansas	Ohio
		(mg.)	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)
9	L*	1,097	1,146	1,252	85	93	102	880	1,056	1,007	92	80	80
	NL	1,180	999	1,144	88	64	78	879	1,020	1,099	84	70	86
10	L	1,128	1,153	1,202	84	89	81	937	938	1,034	99	81	73
	NL	1,073	1,027	1,249	78	66	88	1,029	972	1,064	84	74	76
11	L	1,134	1,128	1,245	105	67	75	1,053	957	1,027	92	84	68
	NL	1,135	1,103	1,108	76	60	85	1,060	1,054	1,120	78	85	76
Number	L	66	97	107	66	97	107	78	107	117	78	107	117
	NL	97	203	234	97	203	234	104	238	226	104	238	226

* L—Participating in the school lunch program;
NL—Not participating in the school lunch program.

TABLE 14. AVERAGE DAILY NUMBER OF SERVINGS OF FOOD FROM CERTAIN FOOD GROUPS IN 3-DAY DIETS CLASSIFIED ACCORDING TO THREE LEVELS OF NUTRIENT INTAKE.

	Level of nutrient intake*	Children		I	II	III	IV	V	VI
		Number	Percent	Average number of servings daily					
Boys									
Iowa	1	35	21	0.7	1.0	2.6	3.6	2.1	4.4
	2	91	56	0.5	0.8	2.7	2.9	1.6	4.9
	3	36	23	0.3	0.4	2.2	2.2	1.2	4.4
Kansas	1	31	10	1.1	1.5	2.9	4.2	2.8	5.2
	2	84	28	0.9	0.8	2.2	3.2	2.4	4.9
	3	185	62	0.5	0.4	1.3	2.3	1.8	4.8
Ohio	1	91	25	1.2	1.7	4.8	3.9	2.2	5.6
	2	124	35	0.9	1.1	3.9	3.4	1.9	5.0
	3	140	40	0.6	0.5	3.4	2.4	2.1	5.6
Girls									
Iowa	1	23	13	0.6	1.0	3.1	3.2	1.6	4.2
	2	101	57	0.6	0.8	2.6	2.7	1.6	3.7
	3	54	30	0.4	0.6	2.1	1.9	1.3	3.7
Kansas	1	27	8	1.6	1.3	2.9	4.5	2.5	5.1
	2	121	35	1.0	1.1	2.3	3.1	2.2	4.1
	3	197	57	0.5	0.5	1.9	2.0	1.8	4.2
Ohio	1	33	9	1.6	1.3	4.2	4.2	2.0	5.0
	2	146	41	0.9	1.2	3.7	3.3	1.8	4.2
	3	176	50	0.5	0.8	3.6	2.3	1.8	4.4

*Designation of level of nutrient intake:

1. All nutrients 100 percent or more of N.R.C. Recommended Allowances.
2. Some less than 100 percent but none less than 67 percent.
3. At least one nutrient less than 67 percent in average daily nutrient intake.

groups, (Kansas boys, Kansas and Ohio girls) half or more of the children had diets in the lowest classification.

The average daily consumption of milk (Group IV) and of the vitamin C-rich fruits and vegetables (Group II) varied directly with dietary classification from Class 1 to 3. With only one exception, the same observation applied to the intake of green and yellow vegetables (Group I) and to the other vegetables and fruits (Group III) (see table 14).

In protein-rich foods (Group V) the diets of Class 1 always exceeded those of Class 3, but the middle class was not always intermediate. Boys with diets in Class 1 averaged 2.1 to 2.8 servings of protein-rich foods daily. This would be the equivalent of 1 serving of meat and about 3 servings of such foods as eggs and legumes. Girls in Class 1 averaged 1.6 to 2.5 servings of the protein-rich foods daily.

No consistent relationship was observed between the use of the foods of Group VI and the adequacy of the diets. Class 1 diets usually contained as much or more of the cereal foods than did the diets of Class 3.

Further study was made of the milk and of the fruit and vegetable intakes of the children at successive years (see figs. 1 and 2 on the following pages). With few exceptions the children whose diets met the allowances averaged $3\frac{1}{2}$ to 4 cups of milk daily. Those with diets in Class 3 had about 2 cups daily. The children with diets in Class 2 were usually intermediate in their milk consumption.

With only one exception, 10-year-old Iowa boys, the children with Class 1 diets averaged at least 1 serving of the vitamin C-rich fruits and vegetables; the children in Class 3 generally averaged less than $\frac{1}{2}$ serving of foods from this group.

The total vegetable and fruit consumption of the children in Class 1 was usually more than 5 servings daily; in contrast, the children with diets in Class 3 usually had about 3 servings of these foods.

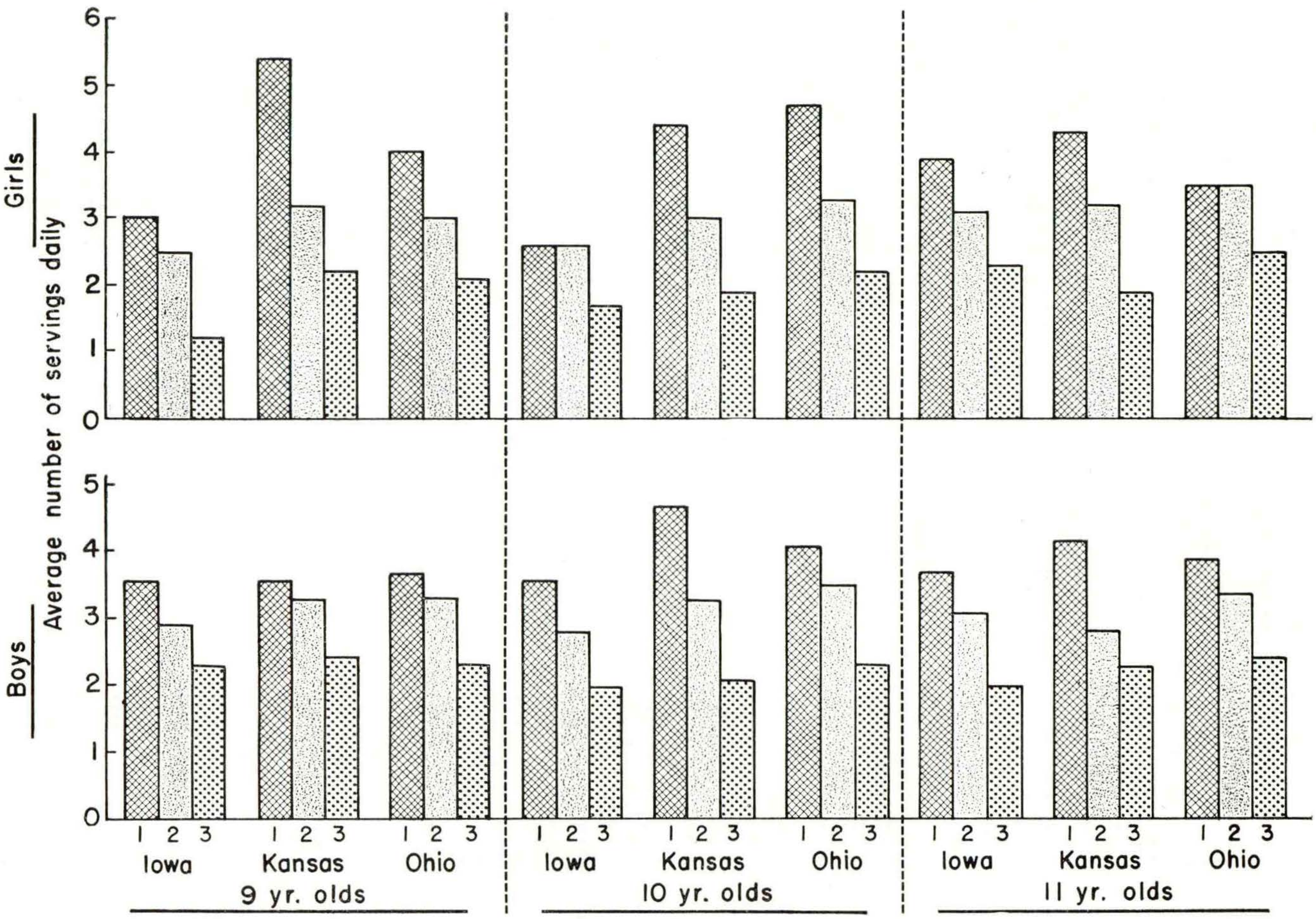

Fig. 1. Mean daily intake of milk by age, sex and state and level of dietary adequacy. (For description of levels 1, 2 and 3, see table 14.)

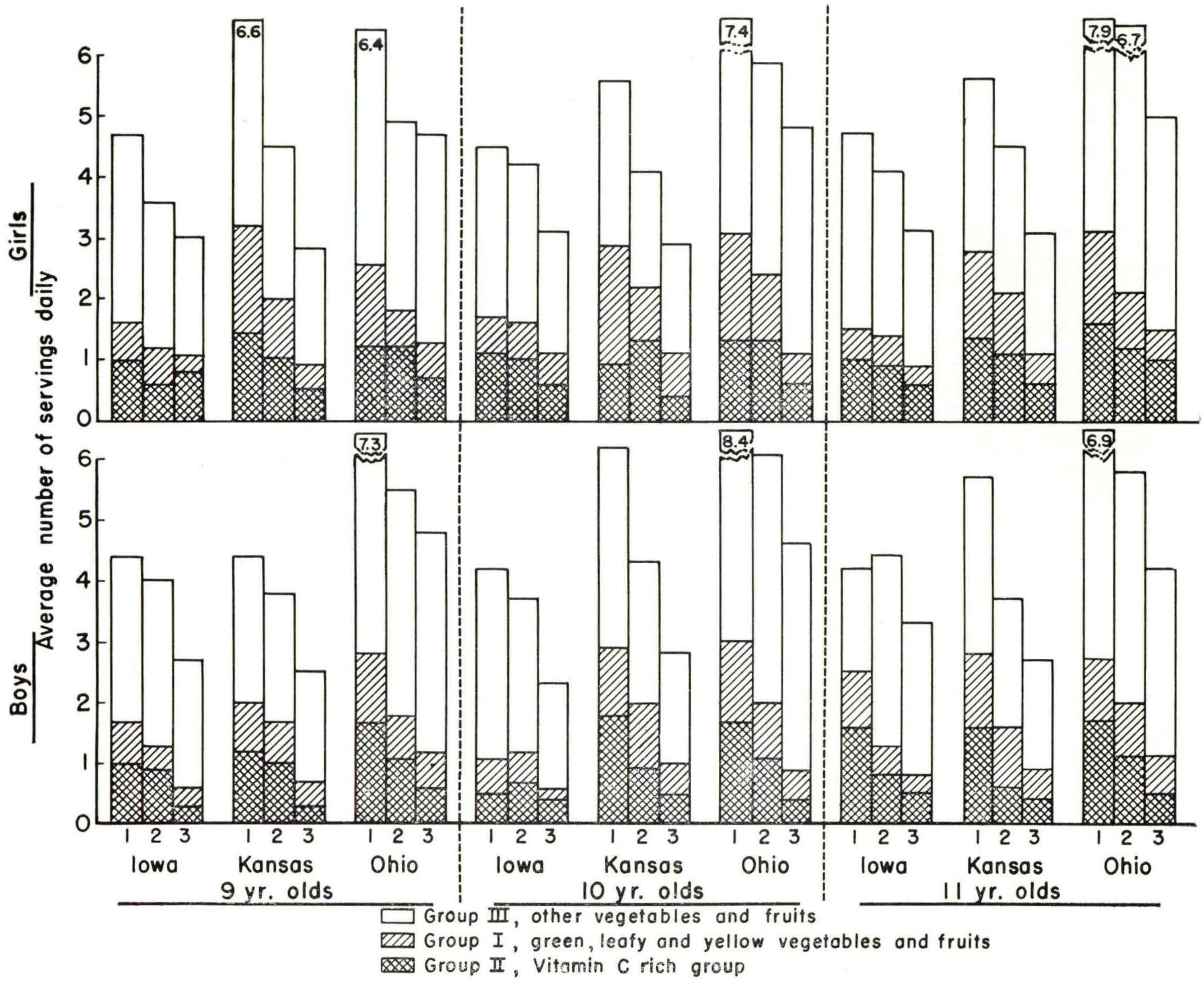

Fig. 2. Mean daily intake of fruits and vegetables by age, sex and state and level of dietary adequacy. (For description of levels 1, 2 and 3, see table 14.)

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