

MEDICAL EVALUATION OF NUTRITIONAL STATUS¹

XV. CALORIC INTAKE OF HIGH SCHOOL STUDENTS IN NEW YORK CITY

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DIETARY studies have shown that the calories furnished by the American diet very frequently are considerably below the levels recommended by the National Research Council (1). This is especially evident in studies in which individual food consumption has been recorded. Data from a number of such studies, some of them previously unpublished, have been compiled by the Committee on Diagnosis and Pathology of Nutritional Deficiencies, Food and Nutrition Board of the National Research Council (2). From 30 to 100 per cent of the persons in these studies are reported to have had a caloric intake less than the recommended level for their specific sex and age group; and 5 to 100 per cent are reported to have had less than 75 per cent of the recommended energy values. The average caloric intake reported for various groups also has been found to be so much below the levels recommended that it has been questioned whether the calorie allowances are too high. There is undoubtedly a need for further study of the energy requirements of persons of each sex and age and of the levels of energy expenditure which are most characteristic of various urban and rural groups in our modern period of labor-saving machines.

In the use of recommended allowances for the evaluation of the adequacy of diets, little attention has been given to the expected or normal variation in individual requirements. A number of factors in addition to sex and age, such as body size, type and hours of

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activity, amount of rest, and climate affect the individual need for calories. Even persons alike as to all these factors differ in their basal energy metabolism. When the only controlled factors in the estimated requirement are sex and age, very large deviations in intake from this requirement must be expected for some individuals and they may have no significance as evidence of an insufficient supply of calories. The more factors affecting energy need that are controlled, the smaller the expected deviations will be; but the sources of individual difference in need are so numerous and the error of estimate for each source is so large that considerable nonsignificant deviation from any estimate of calorie need must be expected. Careful statistical studies have been made of individual variation in basal metabolism and the magnitude of the expected variation in intake for a group due to this factor can be predicted with fair accuracy. But the extent of the variation in individual energy expenditure for various population groups needs to be investigated. For example, in order to evaluate the adequacy of the caloric intake of a group of housewives, not only is an average energy expenditure for such a group needed, but also some measure should be available for the variation in individual needs of such a group.

For two separate groups of high school students in New York City, the individual calorie requirements and the caloric intake have been investigated in considerable detail. In the present report, mean values and the variation in individual values are presented and are considered in relation to other evidence on the adequacy of the caloric intake of the groups.

DESCRIPTION OF DATA

The Sample. A group of about 300 boys and girls attending Fieldston Ethical Culture School, a private high school in New York City, is used in this report for the more detailed study. These pupils were from families of relatively high income and most of them were of nonorthodox Jewish culture. It is reasonable to assume that consumption was not limited by any shortage of food and that each

child could have eaten as much as he desired. Lunch was served at the school and a complete hot meal was available. The mode of living and level of food consumption should be fairly representative of the economically privileged high school students in New York City and probably of other large urban communities.

Data for nearly 2,000 pupils in Seward Park High School, a public school in New York City, are also presented. This group is from families of low income, some of whom were on relief. About 1,450 pupils in this group were from orthodox Jewish homes, and one or both parents were foreign born except in a very few families; about 300 pupils were of Italian parentage; and another 220 were of other or mixed national origins, including a few of native-born parents.

Both groups have previously been described in other reports (3, 4) in the series from an investigation on Medical Evaluation of Nutritional Status. The methods and scope of the Study have been described (3) and a detailed description of the method of collecting and processing the diet records has been published (4). The survey in Fieldston School was made in March and April, 1940, and in Seward Park from March, 1939, to February, 1940.

Diet Record. Diet histories for a two-day period were collected by the interview method from all Fieldston School pupils and from one half of the Seward Park group. A one-day record was taken from the other half of the Seward Park pupils. To assist the pupil in making estimates of servings of different foods, wax models of measured quantities of several items were displayed on the interviewers' desks, and glasses of different sizes, a typical cup, sauce dish, and bowl were also at hand. These were used as standards of reference, and the pupil was questioned carefully as to how much more or less than a selected sample he had consumed of any food. These high school students were interested and very cooperative, and it is believed that their reports were as accurate as this type of estimate can be.

For all Seward Park pupils, a two-day diet record was obtained from the mother or some other member of the family who was responsible for the meals. This estimate of the food eaten by the pupil during a two-day period was combined with the one or two-day record given by the pupil to obtain an average value for a three or four-day period.

It is recognized that the reported amounts of food are approximations and that in some records the error is probably of considerable magnitude. Nevertheless, the estimate of average daily food consumption is thought to be reasonably accurate for most of the pupils. Individual records will err in both directions, that is, be too high and too low, and average values for groups should provide a representative index of their consumption level.

Each pupil was asked whether the "amount" of food eaten in the two-day period was usual, and if not, to explain the difference.

Activities. A complete history of the pupil's activities during the two days for which the diet record was obtained was recorded by the diet interviewer. This included the hour of retiring and rising; school periods of exercise and type of exercise; time spent in walking or in playing games; travel time to school; time spent listening to the radio, studying, or at the movies, etc.

Physical Measurements. For each boy and girl, height and weight were taken, as well as other measurements not used in this report. Height was taken without shoes, and weight was taken with shoes and outer clothing removed.

Medical History. Pertinent to this report is information obtained on special diets which was obtained as part of the medical history. Several pupils were on diets prescribed by their physicians for some health condition or obesity; and a number reported they were on reducing diets without having had a physician's advice. Pupils in Fieldston School reporting a special or reducing diet, and several who were in bed because of illness on one or both days for which the diet record was taken, have been omitted. Records for eight

boys and twelve girls were excluded for one of the aforementioned reasons. Data for all Seward Park pupils for whom both the pupil and family diet report were available have been included.

Physical Examination. Two physicians, specialists in pediatrics, examined the pupils in Fieldston School and rated them as to their general nutritional condition. Five classes were used, namely: (1) obese, marked; (2) obese, moderate; (3) appears normal; (4) undernourished, moderate; (5) undernourished, marked. In Seward Park, pupils were similarly rated by the two school physicians who assisted with the Study. All four physicians were instructed by the medical director for the Study in order to obtain as much uniformity as possible.

METHOD OF ESTIMATING CALORIE REQUIREMENTS

Basal metabolic need for calories was estimated for each pupil from a table by Boothby, Berkson, and Dunn (5) giving average requirements per hour by sex, age, and surface area. The square meters of surface area were estimated from a chart published by Dubois (6) for surface area from height and weight measurements.

From a pupil's report on time devoted to various pursuits during the period for which the diet was recorded, additional calorie needs were estimated at four levels of energy expenditure. Requirements for sedentary hours, such as mealtime and classroom periods, were placed at 40 per cent more than basal; for light exercise, such as dressing, walking, and housework, at 150 per cent more than basal; for moderate exercise, such as gymnastics, playing baseball or handball, and working after school as delivery boy, etc., at 280 per cent; and for severe exercise, such as football, basketball, and dancing, at 600 per cent more than basal. The hours of severe exercise were conservatively estimated as a part of the time spent on the football field or at a dance. Energy metabolism during hours of sleep was taken as 88 per cent of basal. To the total estimated energy expenditure there was added 13 per cent of this total to allow for diges-

tive waste and growth. These values were derived mainly from Bedale (7).

A sample calculation of the calorie requirement per day from a two-day record for a 16-year-old boy is as follows:

	<i>Calories</i>
Basal for 48 hours at 77.3 per hour	3,710
Sleep 17.5 hours, $17.5 \times 77.3 \times .12$	- 162
Sedentary 23.6 hours, $23.6 \times 77.3 \times .4$	730
Light exercise 5.8 hours, $5.8 \times 77.3 \times 1.5$	672
Moderate exercise 1.1 hours, $1.1 \times 77.3 \times 2.8$	238
	<hr/>
Total energy expenditure, two days	5,188
Total per day	2,594
Total plus 13 per cent for growth and waste	2,931

This boy was almost exactly of average height and weight, being 68 inches tall and weighing 138 pounds. His energy requirement is estimated at slightly less than 3,000 calories per day. However, it will be noted that he had little exercise, and for three-fourths of his waking hours he was sitting. He reported his activities as follows: attended school from 9 to 5 o'clock and had one exercise period in the two days; traveled by subway about one hour and walked twenty-five minutes each day; studied or read for about five hours at home in the two days; and spent the remainder of the time eating, dressing, and "just talking." This boy is fairly typical of the private school pupils.

The hours spent at different grades of activity are shown in Table 1 for the boys and girls in Fieldston School and for about 600 pupils in Seward Park High School. Since reports for Saturdays and Sundays are included, there were some pupils with a relatively large amount of exercise, and some with more hours of sleep than is usual at this age.

Among the private school group, 64 per cent of the boys and 54 per cent of the girls had over two but not more than four hours a day of light exercise, mostly dressing or walking and similar light

Table 1. Number of hours per day allotted to sleep and activities classified at four levels for boys and girls in a public and private high school in New York City.

HOURS DAILY	PER CENT OF TOTAL			
	Private School		Public School	
	Boys	Girls	Boys	Girls
Number of Pupils	176	167	295	298
<i>Sleep:</i>				
Total	100.0	100.0	100.0	100.0
6.00- 7.50	1.7	2.4	7.1	3.7
7.51- 8.50	14.2	18.6	19.3	25.8
8.51- 9.50	48.3	47.3	45.8	48.3
9.51-10.50	30.7	26.3	21.7	19.8
10.51-12.00	5.1	5.4	6.1	2.3
<i>Sitting:</i>				
Total	100.0	100.0	100.0	100.0
2.8- 5.0	0	0.6	4.4	3.4
5.1- 6.0	0	1.2	9.5	5.0
6.1- 7.0	1.7	1.8	12.5	8.7
7.1- 8.0	2.3	1.8	14.2	11.7
8.1- 9.0	10.8	11.4	23.4	25.8
9.1-10.0	21.6	21.6	21.0	20.5
10.1-11.0	29.0	26.3	11.2	16.8
11.1-12.0	26.1	21.6	3.1	7.0
12.1-15.0	8.5	13.8	0.7	1.0
<i>Light Exercise:</i>				
Total	100.0	100.0	100.0	100.0
1.1- 2.0	11.9	6.0	1.4	0.3
2.1- 3.0	33.5	24.0	8.5	2.7
3.1- 4.0	30.7	29.9	26.1	15.8
4.1- 5.0	18.2	21.6	23.4	25.5
5.1- 6.0	3.4	9.6	18.6	25.2
6.1- 7.0	0	7.2	8.8	15.4
7.1- 8.0	1.7	1.2	8.5	8.7
8.1-11.0	0.6	0.6	4.7	6.4
<i>Moderate Exercise:</i>				
Total	100.0	100.0	100.0	100.0
None	14.2	42.5	11.5	22.8
0.1-1.0	51.1	38.9	43.7	58.7
1.1-2.0	28.4	18.0	27.1	13.4
2.1-3.0	5.7	0.6	8.8	3.4
3.1-4.0	0.6	0	5.1	1.0
4.1-8.3	0	0	3.7	0.6
<i>Severe Exercise:</i>				
Total	100.0	100.0	100.0	100.0
None	90.9	89.2	38.6	69.5
0.1-1.0	8.5	10.8	49.8	28.5
1.1-2.0	0.6	0	10.5	2.0
2.1-3.0	0	0	1.0	0

activity. About 19 per cent of the girls had more than five hours of light exercise per day as compared with 6 per cent of the boys, but this difference is explained by the fact that more of the boys had some moderately strenuous exercise. It is evident from this tabulation that these high school pupils, on the average, were not very active.

The public school boys and girls were more active in their out-of-school hours and had fewer hours of sleep than the private school pupils. In the public school group, 35 per cent of the boys and 44 per cent of the girls spent nine to twelve hours daily in sedentary pursuits compared with 77 per cent of the boys and 70 per cent of the girls in the private school group. A larger amount of moderate and severe exercise was reported by the public school pupils.

Error of Estimates of Energy Expenditure. Methods for measuring energy output have long been available and careful studies have been made in the past fifty years of basal metabolism and of heat (energy) production in the performance of various types of muscular effort. If an individual's basal metabolism is known, and a detailed record of all activity is available, estimates of energy expenditure can be very accurate. But when estimates make use of average values, as in this Study and in most surveys, the error may be large. The major sources of errors in the estimates in this Study are individual differences in basal metabolism and the use of only four levels of energy output for the many different types of activities. Some error in the estimate of total energy need arises also from errors in estimating body size and from the allowance of a constant 13 per cent for growth and waste for all ages from 11 to 19 inclusive.

Data on individual variation in basal metabolism (mean calories per square meter per hour) are available (5) for the group from which the Mayo Foundation averages used in this Study were derived.² At ages 11 to 19 years, the standard deviation for boys

² There is no agreement on the correct or best standard for basal metabolism during adolescence. The Mayo Foundation values used are higher than a number of others. A study

varied from 6.4 to 7.0 per cent of the mean, and for girls it varied from 6.4 to 7.3 per cent. Thus, there is approximately one chance in twenty that the true basal energy need of an individual boy or girl would be more than 13 per cent greater or less than the estimated level. Obviously, this means that there is considerable variation in the calorie level which will be adequate to meet energy requirements of a specific individual even after account is taken of sex, age, height, and weight.

The magnitude of the errors in the allowances made for energy expended in muscular effort and for growth is, of course, unknown. It is probably conservative to assume that errors from these sources are large enough to increase the standard deviation, or error of estimate, for individual estimates of total daily calorie requirements to about 14 per cent.

ESTIMATED CALORIE REQUIREMENTS

The minimum and maximum estimated individual requirements for boys and girls of each age in the private school and in the public school are shown in Table 2. The range is consistently greater for the public school pupils than for those in the private school, since among the former group there were some with a relatively large amount of moderately severe exercise. In the private school group, the difference between the maximum and minimum requirement for boys of a specific age is as much as 2,000 calories daily, and for girls, the greatest difference is 1,400 calories. In the public school group, there is a spread in the range of 3,200 calories for boys and

by Webster, Harrington, and Wright (8) of thirteen boys and eight girls, most of whom were observed from ages 11 to 16 years, gives mean values for calories per square meter per hour very close to those obtained at the Mayo Foundation for boys and girls aged 11 years, but from 12 to 16 years the mean values are from 5.5 to 7.5 per cent lower than the Mayo standards. Basal metabolism values have been compiled by Rose from several sources and published by Sherman (9). A range with no mean value is given by Rose for boys aged 12 to 14 years and for girls aged 11 to 16 years, and the mid-value of the range is compared with the Mayo standards. For boys aged 12, the Rose standard is 4 per cent lower and from 15 to 18 years, it agrees closely with the Mayo standard, but at ages 11, 13, and 14 years it is from 7 to 18 per cent lower. For girls, the Rose standards (mid-values) range from about 6 per cent lower at 14 years to 18 per cent at 16 years. Such differences in standard values emphasize the necessarily approximate nature of individual requirement levels derived from some average rather than from measurement of individual basal rates.

Table 2. Daily calorie requirements estimated from surface area and reported activity according to sex and age for boys and girls in a private and a public high school in New York City.

AGE	NUMBER	ESTIMATED CALORIES NEEDED DAILY				REQUIREMENT = OR + N.R.C. ALLOWANCE	
		Mean	S.D. ¹	C.V. ²	Range (100's)	Number	Per Cent
PRIVATE SCHOOL—BOYS							
11-12	27	2,576	257	10	22-33	15	55.6
13	38	2,729	389	14	21-41	4	10.5
14	29	2,888	241	8	23-34	4	13.8
15	26	3,023	309	10	25-35	8	30.8
16	28	3,129	304	10	26-37	0	0
17	16	3,181	391	12	26-37	0	0
PRIVATE SCHOOL—GIRLS							
11-12	26	2,412	268	11	18-28	10	38.5
13	24	2,367	250	11	19-29	1	4.2
14	23	2,372	217	9	20-28	0	0
15	29	2,329	226	10	19-30	1	3.4
16	29	2,333	284	12	18-32	11	37.9
17	23	2,320	284	12	19-30	7	30.4
PUBLIC SCHOOL—BOYS							
13	22	2,932	372	13	22-36	5	22.7
14	135	3,148	497	16	18-47	56	41.5
15	247	3,325	511	15	20-51	136	55.1
16	334	3,381	515	15	20-52	55	16.5
17	258	3,407	555	16	23-53	51	19.8
18	97	3,317	518	16	22-45	16	16.5
PUBLIC SCHOOL—GIRLS							
13	25	2,486	359	14	18-32	6	24.0
14	117	2,557	387	15	18-41	26	22.2
15	291	2,485	319	13	18-37	47	16.2
16	300	2,414	300	12	18-36	137	45.7
17	156	2,347	295	13	18-33	59	37.8
18	40	2,373	450	19	18-38	14	35.0

¹ Standard Deviation.

² Coefficient of Variation, or $\frac{SD}{\text{mean}} \times 100$.

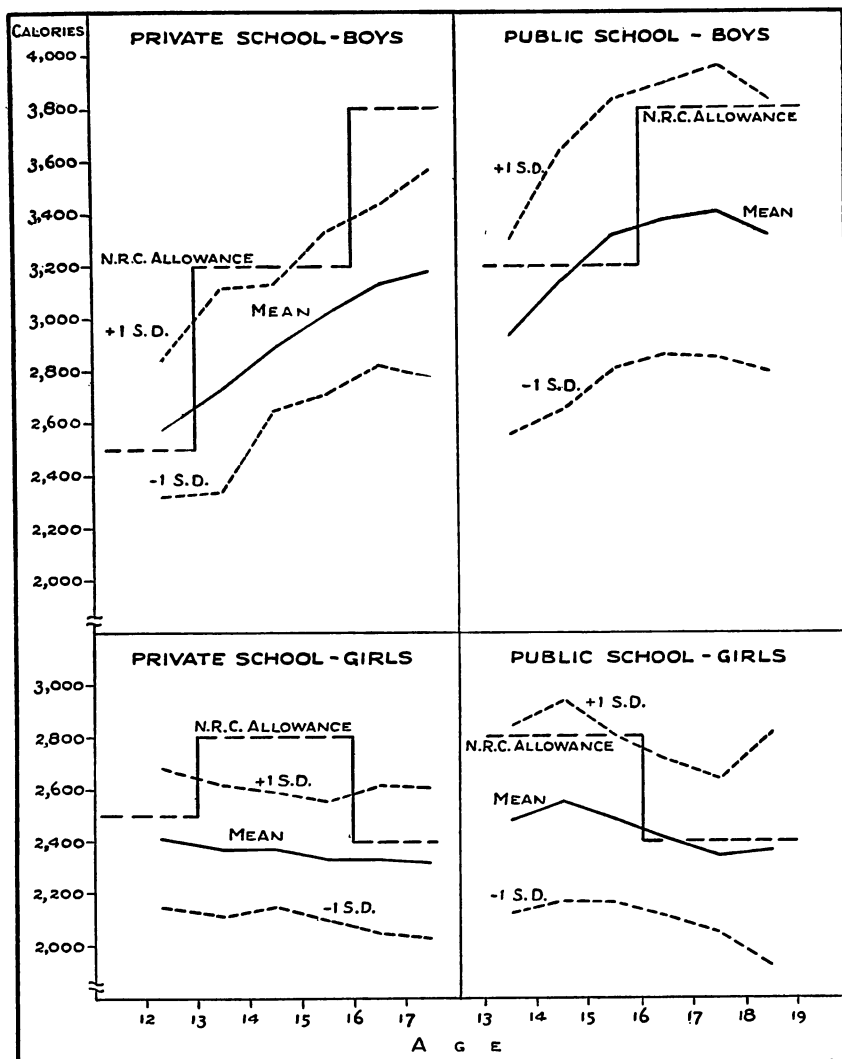


Fig. 1. Estimated mean daily requirement for calories and limits of plus and minus one standard deviation of the distribution of individual requirements at single years of age for boys and girls in a private and in a public high school in New York City compared with daily allowances recommended by the National Research Council.

2,300 calories for girls. With differences of this magnitude in individual energy need, it is obviously impossible to evaluate the adequacy of caloric intake in terms of its relation to an average or standard allowance.

The mean calorie need for girls changed very little with age, as may be seen in Figure 1 and Table 2. In this, it differs from the recommended allowances which are 2,800 calories at ages 13-15 years and 2,400 calories from 16 to 20 years. The lower level, 2,400 calories, is fairly close to the mean requirements estimated in this Study which varied from 2,320 for girls 17 years old in the private school to 2,557 for those aged 14 years attending the public school.

For boys, there is a steady increase with age in the mean estimated daily requirement for both private and public school groups, but, at each age, the mean for the public school boys is from 200 to 300 calories higher than the mean for private school boys of corresponding age.

The maximum mean daily calorie need in the Study is for public school boys aged 17 years and is 400 calories less than the recommended allowances of 3,800 calories, but at ages 13 to 15 years, the Study averages for the public school group vary from nearly 300 calories less than the recommended allowance to 125 calories more. Estimated mean energy levels for the private school boys are from about 200 to 700 calories less than recommended allowances for corresponding ages, except at ages 11-12 for which the Study mean is slightly higher.

The high calorie allowances recommended for girls aged 13 to 15 years and for boys aged 16 to 18 years are not borne out by the data on activity and body size for these groups. Furthermore, as will be shown, the caloric intake at different ages did not follow the pattern of the recommended allowances.

CALORIC INTAKE OF PRIVATE SCHOOL GROUP

For the diet records of all boys and girls in the private school, including those reported as not typical, the average caloric intake daily by sex and at each year of age is shown in Table 3. For boys, the intake falls into three levels of approximately 2,400, 2,900, and

AGE	BOYS		GIRLS	
	Number	Calories Mean Daily	Number	Calories Mean Daily
11	4	2,478	5	2,139
12	23	2,358	21	2,157
13	38	2,863	24	2,031
14	29	2,908	23	2,155
15	26	2,956	29	2,386
16	28	3,204	29	2,133
17	16	3,247	23	2,088
18	7	3,053	2	2,019

Table 3. Mean caloric intake per day at each age reported by boys and girls at Fieldston School.

3,200 calories for ages 11-12,⁸ 13-15, and 16-18 years, respectively. For girls, differences in the average number of calories by age are relatively small and follow no consistent trend or pattern. Since the number of pupils at each age is small, ages have been grouped for further analysis of the diets.

In Table 4, only diet records reported as “usual” have been included. In addition to the mean and median number of calories daily for sex-age groups, the ranges and standard deviations of the distributions are shown. The exclusion of nontypical food records had little effect on the average calories for most age groups, but for girls aged 16-18 years the mean number of calories was increased considerably. Most of the excluded records were for Saturday and Sunday, and many of the older girls and some of the boys had eaten irregularly. Some of them ate no breakfast, others missed lunch or had no evening meal on Sunday. On the other hand, there were some who ate “unusually” large amounts of food on one or both days.

When the unusual diet records are excluded, the mean intake for girls 11-13 years of age is 2,140 calories, for ages 14-15 is 2,295 calories, and for ages 16-18 is 2,294 calories. The difference in intake

⁸ The 11-year-old boys and girls included were more than 11 years and 9 months with the exception of one girl aged 11 years and 5 months.

SEX AND AGE GROUP	NUMBER	MEAN CALORIES AND STANDARD ERROR	S. D.	C. V.	MEDIAN	RANGE
BOYS—ALL AGES	153	2,922 ± 61	750	26	2,806	
11-12 Years	26	2,438 ± 117	598	25	2,352	1,358-4,050
13 Years	35	2,860 ± 126	746	26	2,790	1,640-4,895
14-15 Years	49	2,949 ± 104	727	25	2,840	1,327-4,520
16-18 Years	43	3,235 ± 110	721	22	3,228	1,830-4,987
GIRLS—ALL AGES	119	2,243 ± 49	538	24	2,170	
11-13 Years	40	2,140 ± 66	420	20	2,078	1,345-3,158
14-15 Years	43	2,295 ± 96	630	27	2,212	1,120-3,827
16-18 Years	36	2,294 ± 78	532	23	2,255	1,445-3,585

Probability of observed differences in means by age occurring by chance:

Boys, $P < .01$

Girls, $P > .05$

Table 4. Estimated calories per day in two-day "usual" diets reported by boys and girls in a private high school in New York City, March-April, 1940.

by age is not significant in a statistical sense because of the great variation in the calories in individual diets and the small numbers of girls in each age group. The median calorie value for each age group is 60 to 90 calories lower than the mean number of calories. The range in energy value of the diets is very great, 1,120 to 3,827 calories,⁴ and is greater than the range for estimated need, but since the caloric intake and estimated requirement are both subject to error, this is to be expected. Although reported as typical diets, variation in caloric content from day to day is no doubt considerable and the extreme values probably represent low-calorie or high-calorie diets rather than the true average intake for the individuals over a longer period.

For boys, the differences among mean calories per day, by age groups, are significant statistically. There is a steady increase with

⁴The range in energy value for these two-day diets is not unusual. For example, from a recent study (10) of twenty-seven college women, in which mean daily caloric intake was determined for weighed, analyzed diets over a seven-day period, the range reported is 1,191 to 3,267 calories and the mean is 2,038 calories.

age, the energy value of diets for boys 16-18 years being on the average about one-third higher than for boys 11-12 years old. The mean daily calories by age were: 2,438 for ages 11-12 years, 2,860 at age 13, 2,949 at ages 14-15, and 3,235 for ages 16-18 years. The median caloric intake is again somewhat lower than the mean. Individual variation at each age is very great and the range wider than that found for girls, the lowest intake being 1,327 and the highest 4,987 calories. The coefficients of variation, however, show that the variation relative to the means was similar for boys and girls.

Relation of Intake to Need. In order to compare individual intake with estimated energy expenditure, the calories in each pupil's diet are expressed as a percentage of his estimated requirement. For brevity, this percentage is termed calorie-per cent. The distributions of these calorie-per cents, averages, and other measures are given in Table 5.

On the average, boys of all ages had 103 per cent of their energy

Table 5. Caloric intake as percentage of estimated individual calorie requirement for boys and girls in a private high school in New York City who stated diet records for two days were typical.

PERCENTAGE OF ESTIMATED ENERGY NEED	NUMBER OF BOYS					NUMBER OF GIRLS			
	Total	Age Group				Total	Age Group		
		11-12	13	14-15	16-18		11-13	14-15	16-18
TOTAL	153	26	35	49	43	119	40	43	36
49.9 or Less	1			1		1		1	
50.0- 69.9	13	3	3	4	3	16	7	5	4
70.0- 89.9	41	10	9	14	8	34	11	10	13
90.0-109.9	42	8	9	14	11	38	16	15	7
110.0-129.9	29	3	6	7	13	15	3	7	5
130.0-149.9	18	1	5	5	7	14	3	4	7
150.0-169.9	6	1		4	1	1		1	
170.0-189.9	2		2						
195	1		1						
Mean Per Cent	103.3	93.5	108.4	100.9	107.8	96.3	92.0	98.5	98.6
Stan. Error of Mean	2.24	4.43	5.53	3.89	3.86	2.26	3.25	4.13	4.29
Stan. Deviation	27.6	22.6	32.7	27.2	25.3	24.6	20.5	27.1	25.8
Coeff. of Variation	27	24	30	27	23	26	22	27	26

needs and girls had 96 per cent. Thus, the average caloric intake approximately equalled the average need for each sex. The difference between the boys and girls is, however, moderately significant, since a difference as great as 7 per cent in the mean percentages has a probability (t test) of only .04. The mean percentage of energy need furnished by the diets was consistently lower for girls than for boys at each age, but the difference is relatively large at ages 13 and 16 to 18 years.

For each sex, the youngest age group had on the average the least adequate intake of calories. Among boys, only those aged 11-12 years had a mean calorie-per cent less than 100. However, for neither boys nor girls was the variation among means of calorie-per cents for the different age groups statistically significant. The mean calorie-per cent of 92 for girls aged 11-13 years is significantly less than 100. Other evidence discussed in a later section suggests that the low calorie-per cents for both boys and girls in the youngest age group are the result of insufficient food consumption rather than of an overestimate of need for some pupils.

For individual boys and girls, the calorie-per cents differ widely as shown by the distributions in Table 5. Only 27 per cent of the boys and 32 per cent of the girls of all ages are found to have from 90 to 109 per cent of their estimated energy expenditure during the two-day period; but 73 per cent of each sex had from 70 to 129 per cent of their energy need.

The significance of low and high calorie-per cents in the distributions shown in Table 5 should be judged in relation to the variation to be expected from the errors of estimates for the various factors which entered into the derived calorie-per cents. For the most part, these errors are unknown, but the use of assumed values is helpful, if only to illustrate the difficulty of selecting the deficient diets. For estimated individual energy requirement, an expected standard deviation from errors of estimate of 14 per cent has already been discussed (page 13). The calorie content of the diet is

the other factor in the quotient, calorie-per cent, and also has an error of estimate which arises both from faulty reporting and from errors in estimating calories in the reported diet. A standard deviation of error equal to 10 per cent of the calculated calorie content seems conservative. On the basis of these two errors of estimate, the standard deviation for the individual calorie-per cent determinations is 17 per cent,⁵ and only values which are 35 per cent less or more than 100 would have, in a statistical sense, a significantly high probability that the calorie intake was less or greater than energy expenditure for reasons other than accidental errors. Furthermore, because of the error of each calorie-per cent, some diets for which the calorie-per cent differs only slightly from 100 would really be out of balance. Regardless of the accuracy of these assumed errors, it is apparent that only markedly deficient diets can be identified.

With errors of the assumed magnitude for calorie content and estimated calorie requirement, the expected distribution of calorie-per cents would have a standard deviation of 17 if all diets were in fact adequate for the individual. The observed standard deviation for calorie-per cents, in Table 5, is 28 for boys and 25 for girls, indicating a considerably wider spread in the distribution than is accounted for by these assumed errors. The "expected" proportion of each group with calorie-per cents 130 or above and less than 70 is 4 per cent. Among boys, the frequency of calorie-per cents 130 or above is 18 per cent of the total and less than 70 is 9 per cent of the total. Among girls, those with calorie-per cents of 130 or above were 13 per cent of the total and with calorie-per cents of less than

⁵ The standard deviation for a quotient (11) is:

$$\sigma_{x_1/x_2} = \frac{x_1}{x_2} \sqrt{v_1 + v_2 - 2 r_{1.2} v_1 v_2}$$

and v is the standard deviation divided by the mean.

Since there should be no correlation between the error in estimating energy requirements and the error in calorie content of the diet, the r factor in the formula can be omitted. The mean calorie requirement and the mean calorie content of diets should be equal, so the standard deviation for errors in estimating the calorie-per cent becomes:

$$\sigma = 1 \sqrt{.14^2 + .10^2} = .172$$

70 were 14 per cent of the total. Unless the errors were much larger than has been assumed, there were both boys and girls in this high-income group on diets that were too high and too low in calories.

Relation of Intake to Basal Energy. It is of interest to examine the ratio of caloric intake to basal energy for these boys and girls, since it is frequently not feasible to obtain detailed information on amount and type of activity, although height and weight may be known. The percentages of basal energy furnished by the diets are shown in Table 6. For girls, the mean percentage was 55 per cent above basal and for boys it was 69 per cent, and the difference is statistically very significant ($P < .01$). Some difference by age is shown for each sex, but for neither sex is the variation among age means significant.

Table 6. Caloric intake as percentage of estimated basal energy for individual boys and girls in a private high school in New York City who stated diet records for two days were typical.

PERCENTAGE OF BASAL ENERGY	NUMBER OF BOYS					NUMBER OF GIRLS			
	Total	Age Group				Total	Age Group		
		11-12	13	14-15	16-18		11-13	14-15	16-18
TOTAL	153	26	35	49	43	119	40	43	36
67	1			1		1		1	
80-99	2	1		0	1	6	1	5	
100-119	19	5	3	8	3	14	7	1	6
120-139	17	1	4	7	5	17	5	7	5
140-159	35	9	9	10	7	36	16	9	11
160-179	26	5	8	6	7	17	7	8	2
180-199	17	2	1	5	9	11	1	5	5
200-219	13	2	2	5	4	11	2	4	5
220-239	11		4	3	4	4	1	2	1
240-259	9		2	4	3	2		1	1
260-279	1	1							
280-299	1		1						
337	1		1						
Mean Per Cent	168.8	155.0	177.4	164.7	174.9	155.0	148.3	157.0	160.3
Stan. Error of Mean	3.65	7.79	8.68	6.47	6.33	3.20	4.63	6.32	6.24
Stan. Deviation	45.1	39.7	51.4	45.3	41.5	36.5	29.3	41.4	37.4
Coeff. of Variation	27	26	29	27	24	23	20	26	23

Individual variation is large for caloric intake in excess of basal energy, but the coefficients of variation (standard deviation as a percentage of the mean) are of the same magnitude as found for the distributions of percentages of estimated total caloric need furnished by the diets. This suggests that for some of these high school pupils the amount of exercise played a minor part in determining the caloric intake, especially for the more extreme dietary levels. If a consistent relationship existed between amount of muscular activity and caloric intake above basal need, a lower coefficient of variation for calorie-per cents than for ratio of caloric intake to basal would be expected.

To some extent, the frequency of deficient diets is shown by the prevalence of low percentages of basal energy, since even sedentary pupils would require a caloric intake about 40 per cent above basal need. The degree of the deficiency, however, is less well indicated than when total requirement is estimated, and an insufficient diet for the more active child is not revealed. Little information is furnished concerning excessive consumption of calories by a high ratio of calories to basal need, since the upper limit of caloric need is completely dependent on the amount of exercise.

It will be noted that a few children reported diets with less calories than the estimated basal energy. An actual intake below basal need is very unlikely, but a ratio less than 1.0 may be expected occasionally as a result of the error of estimate for basal energy and for the caloric content of a diet, and of day-to-day variation in intake.

RELATION OF WEIGHT TO CALORIC INTAKE

Since an imbalance between the consumption of calories and energy requirements produces a gain or loss in weight, the relationship between weight and the reported diets has been examined for the private school pupils. The weight recorded in the Study examination for each child was compared with the Baldwin-Wood

standard weight for height and age, after adjustment of the latter for weight of clothing. The distributions of the percentage deviations from this standard are shown in Table 7. Both boys and girls tend to be heavier than this standard weight, and 26 per cent of the boys and 23 per cent of the girls were 15 per cent or more above their weight standard. Only 1 per cent of the boys and 2 per cent of the girls were 15 per cent below their weight standard, but 6 and 11 per cent, respectively, were from 7.5 to 15 per cent underweight. Some differences by age in the proportions overweight and underweight may be mentioned. At ages 11-12 years, 48 per cent of the boys were 15 per cent or more above standard weight, and the corresponding percentage declined to 12 per cent at ages 14 and 15 years, then increased again to 24 per cent in the older ages. There is little difference by age in the proportion of boys who were 7.5 per cent or more underweight. Among girls the trend toward excess weight is similar to that for boys. Of those aged 11-12 years,

Table 7. Weight of boys and girls in a private school in relation to Baldwin-Wood standard weight for sex, age, and height.

SEX AND AGE	NUMBER	PER CENT IN SPECIFIED WEIGHT GROUP						
		TOTAL	Percentage Over Standard			Percentage Under Standard		
			15.0+	7.5- 14.9	0-7.4	0.1- 7.4	7.5- 14.9	15.0+
BOYS—TOTAL	179	100.0	26.3	14.5	28.5	23.5	6.1	1.1
11-12 Years	29	100.0	48.3	10.3	13.8	20.7	3.4	3.4
13 Years	39	100.0	33.3	12.8	30.8	17.9	5.1	0
14-15 Years	58	100.0	12.1	17.2	36.2	25.9	6.9	1.7
16-18 Years	53	100.0	24.5	15.1	26.4	26.4	7.5	0
GIRLS—TOTAL	168	100.0	23.2	17.3	31.0	15.5	11.3	1.8
11-12 Years	27	100.0	29.6	3.7	22.2	14.8	29.6	0
13 Years	24	100.0	25.0	20.8	37.5	8.3	4.2	4.2
14-15 Years	56	100.0	17.9	19.6	33.9	16.1	8.9	3.6
16-18 Years	61	100.0	24.6	19.7	29.5	18.0	8.2	0

30 per cent were 15 per cent or more overweight, the proportion declined to 18 per cent at ages 14-15 and increased to 25 per cent at 16 years or older. The proportions underweight among girls show a sharp difference with age, and 30 per cent of those aged 11-12 years were 7.5 per cent or more underweight, but at older ages only 8 to 12 per cent of the girls were as much as 7.5 per cent underweight.

It may be questioned whether the Baldwin-Wood standard weight table for American boys and girls is applicable to this Jewish group. The physicians' rating on nutritional status are shown in Table 8 according to three classifications, namely, (1) obese, moderate or marked; (2) normal; and (3) undernourished, moderate or marked. About 12 per cent of the boys and 14 per cent of the girls were rated obese, and although these proportions are roughly half as great as the proportions 15 per cent overweight, it is evident that many in the group were too fat and the excess weight is not explained on the basis of body build. The physicians considered 11 per cent of the boys and 5 per cent of the girls undernourished to some degree, as compared with 7 per cent of the boys and 13 per cent of the girls found to be 7.5 per cent or more

Table 8. Physicians' ratings on nutritional status of boys and girls in a private school in New York City.

SEX AND AGE	NUMBER	PER CENT WITH SPECIFIED RATING			
		Total	Obese	Normal	Under-Nourished
BOYS—TOTAL	179	100.0	11.7	77.7	10.6
11-12 Years	29	100.0	27.6	51.7	20.7
13 Years	39	100.0	15.4	74.4	10.3
14-15 Years	58	100.0	3.4	87.9	8.6
16-18 Years	53	100.0	9.4	83.0	7.5
GIRLS—TOTAL	168	100.0	14.3	80.4	5.4
11-12 Years	27	100.0	11.1	70.4	18.5
13 Years	24	100.0	8.3	87.5	4.2
14-15 Years	56	100.0	14.3	80.4	5.4
16-18 Years	61	100.0	18.0	82.0	0

below the standard weight. Weight was well correlated with the physicians' rating of obesity, and the boys, with one exception, who were rated obese were 15 per cent or more overweight. The obese girls varied more in the percentage of excess weight and were distributed over the range of 7 per cent or more overweight. The rating of "undernourished," however, correlated poorly with weight, and other factors apparently had more influence on the physicians' appraisal. Two boys and two girls rated as undernourished were above their standard weights, and one girl who was 18 per cent underweight was not rated as undernourished. For correlation with caloric intake, the Baldwin-Wood standard weights seem to afford a satisfactory base for classifying the weight status of these pupils.

When a direct comparison is made between weight status of the individual and the calorie level of his diet, a positive correlation, which presumably should be expected, is not found. The distributions according to calorie-per cent for boys and girls in each weight

Table 9. Percentage deviation of weight from standard weights for sex, age, and height and caloric intake as percentage of estimated individual requirement for boys and girls of all ages in a private high school in New York City.

PERCENTAGE + OR - STANDARD WEIGHT	NUMBER	PER CENT OF PUPILS WITH CALORIC INTAKE SPECIFIED PERCENTAGE OF NEED						
		Total	69.9 or Less	70.0- 84.9	85.0- 99.9	100.0- 114.9	115.0- 129.9	130.0 or More
BOYS—TOTAL	153	100.0	9.2	23.5	19.6	18.3	11.8	17.7
+15.0 or More	36	100.0	22.2	36.1	16.7	13.9	2.8	8.3
+ 7.5-14.9	22	100.0	9.1	22.7	22.7	18.2	13.6	13.6
+ 0.0- 7.4	47	100.0	6.4	19.1	17.0	21.3	14.9	21.3
- 0.1- 7.4	35	100.0	0	20.0	20.0	22.9	11.4	25.7
- 7.5 or More	13	100.0	7.7	15.4	30.8	7.7	23.1	15.4
GIRLS—TOTAL	119	100.0	14.3	17.6	29.4	16.8	9.2	12.6
+15.0 or More	24	100.0	29.2	25.0	33.3	4.2	4.2	4.2
+ 7.5-14.9	17	100.0	0	35.3	41.2	5.9	11.8	5.9
+ 0.0- 7.4	41	100.0	17.1	19.5	19.5	24.4	9.8	9.8
- 0.1- 7.4	21	100.0	9.5	0	42.9	19.0	0	28.6
- 7.5 or More	16	100.0	6.3	6.3	18.7	25.0	25.0	18.7

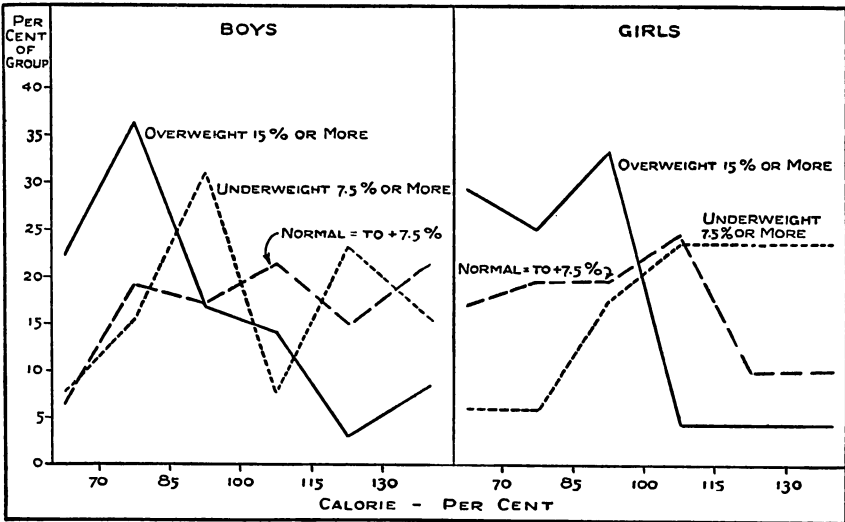


Fig. 2. Percentage distribution of diets according to per cent of calorie need furnished for pupils in a private high school whose weight deviated various per cents from the Baldwin-Wood age-height standard.

status group are shown in Table 9, and three groups are shown in Figure 2. It is apparent that both underweight and overweight pupils reported diets of both low and high calorie-per cent. There is, however, a rather definite *inverse* relationship between weight status and calorie-per cent. Thus, among those 15 per cent or more overweight, 22 per cent of the boys and 29 per cent of the girls received less than 70 per cent of their estimated energy need and only 8 and 4 per cent of them, respectively, received 130 per cent or more of their energy need. A similar inverse association is shown for those underweight 7.5 per cent or more: 8 per cent of the boys and 6 per cent of the girls had diets furnishing less than 70 per cent of the calories needed, but 15 and 19 per cent of them had diets with 130 per cent or more of calories needed to balance their estimated energy expenditure. The intermediate weight groups also tend to follow the same pattern, and the lower calorie-per cent diets increase in frequency as weight increases and vice versa.

Since obesity increases surface area and therefore the basal energy value and total requirement estimate, and thinness does the

reverse, this has a tendency to overemphasize the difference in actual requirement. A further tabulation is presented, therefore, which shows the distributions of boys and girls according to the calories consumed daily per inch of height. While calories per inch eliminates the effect of extremes of weight, there is no adjustment for need as the result of amount of physical exercise. In Table 10, it is shown that calories per inch also have a tendency to vary inversely with weight. The proportion of those markedly overweight who had a low intake of calories per inch is higher than the proportion of the underweight group, and, inversely, the proportion with a high intake of calories per inch is higher for the underweight group than for the overweight group.

There is no direct evidence to interpret and explain the finding

Table 10. Percentage deviation of weight from standard weight for sex, age, and height and caloric intake per inch of height for boys and girls of all ages in a private school in New York City.

CALORIES DAILY PER INCH OF HEIGHT	PER CENT OF PUPILS IN EACH WEIGHT CLASS WITH SPECIFIED CALORIES					
	Total	Weight Class—Percentage Deviation from Standard				
		+15.0 or More	+14.9 to +7.5	+7.4 to +0	-0.1 to -7.4	-7.5 or More
Boys—Number	153	36	22	47	35	13
ALL INTAKES	100.0	100.0	100.0	100.0	100.0	100.0
33 or Less	12.4	22.2	13.6	8.5	5.7	15.4
34-41	34.0	44.4	27.3	29.8	34.3	30.8
42-49	26.1	19.4	31.8	27.7	25.7	30.8
50-57	15.0	5.6	13.6	19.1	20.0	15.4
58 or More	12.4	8.3	13.6	14.9	14.3	7.7
Girls—Number	119	24	17	41	21	16
ALL INTAKES	100.0	100.0	100.0	100.0	100.0	100.0
26 or Less	13.4	25.0	0	17.1	9.5	6.3
27-32	22.7	20.8	41.2	22.0	14.3	18.8
33-38	31.9	29.2	35.3	26.8	42.9	31.2
39-44	18.5	12.5	11.8	24.4	9.5	31.2
45 or More	13.4	12.5	11.8	9.8	23.8	12.5

of an inverse relationship between calories and weight, but it is believed that three factors were operating to cause it. One important factor is that the adolescent boy and girl become "weight conscious" and those overweight seek to reduce or to control their weight. This interest in slimness on the part of young women is well known and is further supported by the fact that seven of the thirty-nine girls 15 per cent or more overweight reported they were reducing. Only two boys, 12 and 13 years old, reported reducing diets. The majority of both boys and girls reporting "unusual" diets were above normal weight and had eaten very low-calorie diets in the record period. The students were not asked if they were trying to lose weight, but it seems evident that many were. A second factor is the health supervision given to these private school pupils by both school and private physicians. It is reasonable to assume that those who were markedly overweight or underweight were advised on diet. In addition to these two factors which operate through a deliberate or conscious attention to food intake, changing energy need during adolescence has considerable effect on the appetite and consumption level. For example, a thin, rapidly growing boy may eat very heartily. Growth is likely to occur in spurts and weight gain frequently is not maintained although the appetite for large amounts of food is stimulated. Over a period of time, weight catches up and the habit of eating heartily may continue long enough to cause overweight, but in time, the reduced physiological need effectively limits intake through reduced appetite. Thus, there is a significant time lag between consumption level and weight, which is very important during adolescence. In a cross-sectional survey which compares weight at a given time with diet at a given time, the above factors operate to produce the inverse relationship observed.

The limitations of a cross-sectional survey are sometimes overlooked, and the identification of persons with a deficient intake and close correlation between diet and individual status are expected.

Since weight at a given time reflects the cumulative effect of previous consumption level, it is not necessarily correlated with the current dietary intake. Data on change in weight are needed to determine whether caloric intake is in balance with energy expenditure. High positive correlation between weight change and caloric intake can be expected only if observations are made over a sufficient period of time and if caloric intake can be expressed in terms of its relation to a carefully determined individual requirement. Individual requirements differ so widely that consumption below an average need may be entirely adequate and an over-average intake may be insufficient.

It is pertinent to mention what information of value is obtained from a cross-sectional survey, if it does not permit the selection of undernourished persons. In brief, averages and distributions describe the group situation grossly and give an indication of the probable prevalence and degree of insufficiency in the diets, provided that the requirement level for the specific group can be determined with fair accuracy. The more prevalent and the more severe the deficiency is among any group, the more clearly will it be shown. Comparison of groups will reveal real differences in consumption levels and in the extent and frequency of deviations from an estimated need. Knowledge of group dietary deficiencies can be useful for guidance in shaping public or community policies and programs affecting nutrition. It affords sound evidence for selecting groups which are in need of more intensive or more individual investigation and attention.

For this group of privileged children, the data on consumption level for calories furnish a good general description of their status with respect to calories. On the average, the calorie values for boys and girls were very close to their estimated energy requirements, and judged by their weights, the majority of these pupils had been consuming adequate calories. Furthermore, the prevalence of obese and of underweight children is consistent with the dietary evidence

that a considerable number of children had higher calorie diets and lower calorie diets than their requirements. Although many of the very low-calorie diets were for obese children, these suggest an inadequate *current* intake, and reducing diets may present a nutritional problem as important as inadequate diets which have previously produced underweight.

CALORIC INTAKE OF LOW-INCOME GROUP

Data on caloric intake of the public school pupils are presented for three separate groups: Jewish, Italian, and all other white pupils. For convenience, these are referred to as cultural groups. For each sex, the findings are given for two age groups, 13-15 years and 16-19 years. From the age distribution of the public school pupils, shown in Table 11, it is apparent that this group is more heavily weighted with older boys and girls than is the private school group. The number of 13-year-old pupils in the public school is so small that the 13-15 year-old group will be compared with the 14-15 year-old group in the private school.

Calories Daily. The mean daily caloric intake for specific sex-age and cultural groups and various measures of the distributions are shown in Table 12.

Table 11. Age distribution of boys and girls with three or four-day diet records in a public school in New York City.

AGE	BOYS			GIRLS		
	Jewish	Italian	Other	Jewish	Italian	Other
ALL AGES	100.0	100.0	100.0	100.0	100.0	100.0
13	2.8	1.5		2.5	1.0	5.1
14	11.8	14.9	11.3	13.2	14.9	7.7
15	26.1	15.9	19.9	31.3	36.6	24.4
16	29.8	30.8	24.8	32.3	24.8	34.6
17	21.9	25.4	28.4	15.7	17.8	24.4
18	6.6	10.4	14.9	4.6	4.0	3.8
19	0.9	1.0	0.7	0.4	1.0	
Number of Pupils	739	201	141	713	101	78

Among the boys, the mean daily caloric intake is somewhat higher for the older than for the younger age group in each cultural group, but the difference by age is not significant statistically for any of the cultural groups. For girls, the difference by age was not consistent, but for two cultural groups the mean intake is slightly higher for ages 13-15 years than for ages 16-19 years. Only for the Jewish girls is the higher caloric intake at ages 13-15 years significant; the probability of the difference of 88 calories being due to sampling is .01-.02.

When specific sex-age groups for the three cultural groups are

Table 12. Mean calories daily, median, range, and measures of dispersion for distributions of individual caloric intake for boys and girls in a public school in New York City for whom three or four-day diet records were obtained.

CULTURAL GROUPS SEX AND AGE	NUMBER	MEAN CALORIES AND STANDARD ERROR	S. D.	C. V.	MEDIAN	RANGE
<i>Boys:</i>						
Jewish	739	2,660± 22	596	22	2,603	
13-15 Years	301	2,614± 32	568	22	2,559	1,242-5,296
16-19 Years	438	2,691± 29	613	23	2,638	983-4,836
Italian	201	2,878± 47	672	23	2,830	
13-15 Years	65	2,757± 75	604	22	2,767	1,298-4,675
16-19 Years	136	2,936± 60	696	24	2,848	1,612-5,505
Other	141	3,034± 63	743	24	3,075	
13-15 Years	44	2,918± 82	542	19	2,967	1,901-4,386
16-19 Years	97	3,087± 83	815	26	3,150	1,580-5,472
<i>Girls:</i>						
Jewish	713	2,062± 18	483	23	2,025	
13-15 Years	335	2,108± 28	518	25	2,071	722-3,795
16-19 Years	378	2,020± 23	447	22	1,983	900-3,576
Italian	101	2,281± 47	468	21	2,286	
13-15 Years	53	2,249± 61	446	20	2,285	1,147-3,236
16-19 Years	48	2,317± 71	493	21	2,289	1,401-3,685
Other	78	2,319± 69	611	26	2,233	
13-15 Years	29	2,431± 107	576	24	2,450	1,649-3,753
16-19 Years	49	2,253± 90	628	28	2,150	1,345-3,921

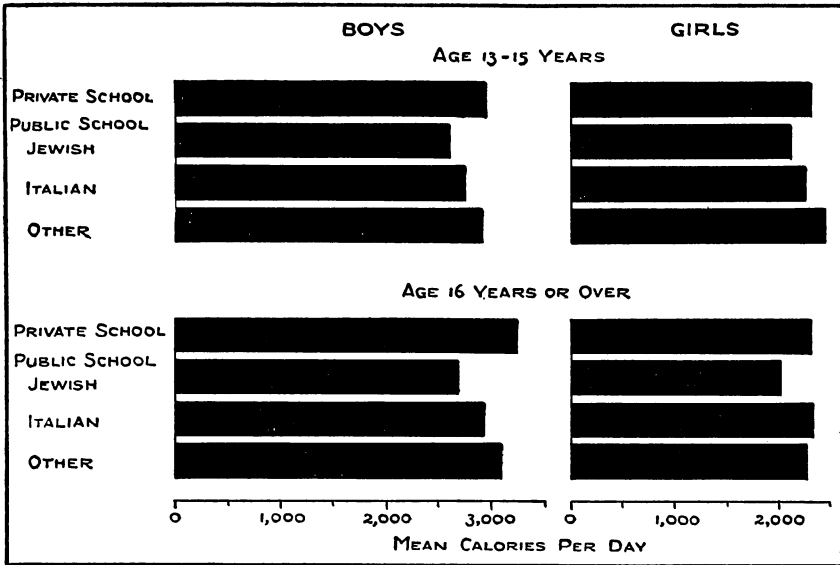


Fig. 3. Mean caloric intakes per day reported for boys and girls in a public school compared with means for private school pupils in New York City. Public school pupils aged 13-15 years compared with private school pupils aged 14-15 years.

compared, it is found that the mean caloric intake is lowest for the Jewish group and highest for the "other" or miscellaneous group. As shown in Figure 3, this order is consistent with the exception that Italian girls aged 16-19 years had a slightly higher intake than girls classified as "other." However, the differences between the mean daily calories for Italians and "others" are not significant statistically for any sex-age group. Also, at ages 13-15 years, the differences between mean calories for Jewish and Italian boys, and for Jewish and Italian girls are not significant. But at ages 16-19 years, Jewish boys and girls had a significantly lower caloric intake than the Italian boys and girls; and the caloric intake for each Jewish sex-age group is significantly lower than that for the corresponding sex-age group of the "other" cultural group. For each significant difference between mean calories which is mentioned, the probability is $<.01$; nonsignificant differences had a probability $>.05$.

In Figure 3, the mean caloric intake of specific sex-age groups

in the private school is compared with means for the public school groups. Girls aged 16-18 years in the private school had a significantly higher caloric intake on the average than Jewish girls aged 16-19 years in the public school ($P < .01$),⁶ but the mean intake for private school girls did not differ significantly from any other public school group. For boys in the private school, the mean caloric intake

Table 13. Caloric intake as percentage of estimated individual requirement for boys and girls in a public school in New York City for whom three or four-day diet records were obtained.

CULTURAL GROUPS SEX AND AGE	NUMBER ¹	CALORIE-PER CENT MEAN AND STANDARD ERROR	STANDARD DEVIATION	COEFFICIENT OF VARIATION	MEDIAN
<i>Boys:</i>					
Jewish	692	81.6±0.82	21.7	27	81.3
13-15 Years	290	82.5±1.29	22.0	27	82.7
16-19 Years	402	80.9±1.07	21.5	27	80.5
Italian	197	91.0±1.76	24.7	27	88.4
13-15 Years	65	89.3±3.26	26.3	29	86.6
16-19 Years	132	91.9±2.09	24.0	26	90.1
Other	136	92.5±2.02	23.5	25	93.7
13-15 Years	42	92.6±3.03	19.6	21	93.4
16-19 Years	94	92.5±2.59	25.1	27	93.8
<i>Girls:</i>					
Jewish	694	86.0±0.90	23.8	28	85.0
13-15 Years	326	85.6±1.37	24.7	29	83.9
16-19 Years	368	86.3±1.20	23.1	27	85.9
Italian	91	97.8±2.93	27.9	29	94.6
13-15 Years	51	95.0±3.64	26.0	27	89.6
16-19 Years	40	101.2±4.77	30.2	30	97.0
Other	75	97.0±3.48	30.1	31	93.2
13-15 Years	28	99.1±4.37	23.1	23	106.0
16-19 Years	47	95.7±4.93	33.8	35	87.5

¹ Pupils for whom height and weight were not available are omitted.

⁶ If unusual and reducing diets had not been excluded from the private school group, the intake for these older girls would not be significantly higher than the intake for Jewish girls in the public school (*see* Table 3). In the public school, the number of diets reported as unusual was so small that the means would not be affected if they were excluded.

for each age group is higher than the mean for the corresponding age group of Jewish boys in the public school ($P < .01$); and at ages 16-18 years the mean intake for the private school group is also significantly higher than that for Italian boys ($P .01-.02$).

Intake in Relation to Requirement. The caloric intake as a percentage of the estimated individual requirement is shown for each of the various public school groups in Tables 13 and 14, and in Figure 4. The mean calorie-per cents do not differ significantly by age for either sex in any cultural group. Comparisons between sexes and cultural groups and with the private school pupils, therefore, are made for combined age groups.

Girls had, on the average, more adequate consumption of calories than boys. For each cultural group in the public school, the mean calorie-per cent for boys is significantly less than 100 per cent of need, and Jewish boys had, on the average, only 82 per cent of their estimated energy requirement. Among girls, only for the Jewish group is the mean calorie-per cent significantly less than the estimated need.

When mean calorie-per cents for the cultural groups are com-

Table 14. Percentage distributions of three or four-day diets according to the percentage of estimated individual calorie requirement for boys and girls in a public school in New York City.

PERCENTAGE OF REQUIREMENT	BOYS			GIRLS		
	Jewish	Italian	Other	Jewish	Italian	Other
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
49.9 or Less	5.6	1.5	2.9	4.3	1.1	2.7
50.0- 69.9	25.3	16.8	19.1	22.3	14.3	20.0
70.0- 89.9	37.1	34.5	22.1	33.0	29.7	24.0
90.0-109.9	23.3	27.9	34.6	24.8	25.3	21.3
110.0-129.9	6.4	11.2	15.4	11.7	15.4	20.0
130.0-149.9	1.7	5.6	4.4	3.3	9.9	6.7
150.0-169.9	0.3	2.0	0.7	0.3	3.3	1.3
170.0 or More	0.3	0.5	0.7	0.3	1.1	4.0
Number of Pupils	692	197	136	694	91	75

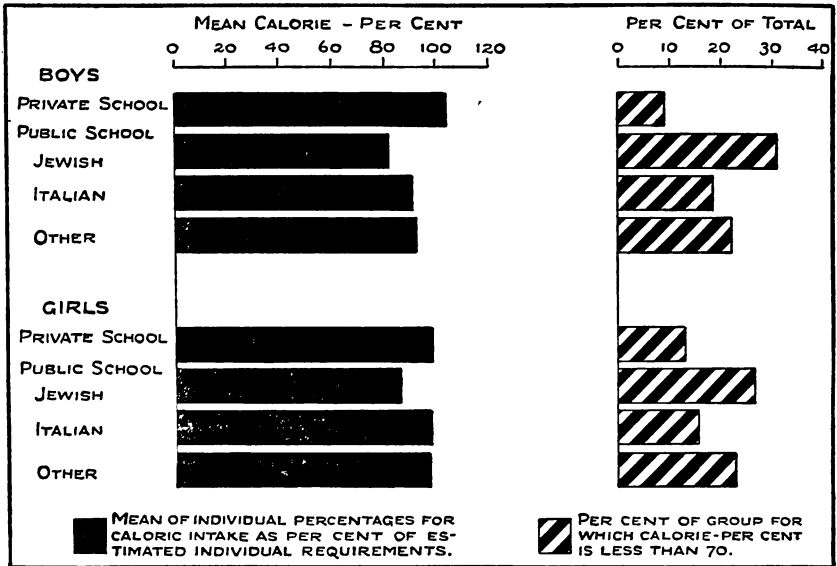


Fig. 4. Caloric intake in relation to estimated individual calorie need for private school pupils aged 14-18 years and public school pupils aged 13-19 years.

pared, both the Jewish boys and Jewish girls are found to have a significantly lower mean calorie-per cent than those of the same sex in either of the other groups ($P < .01$). But mean calorie-per cents for Italians and "others" differ very little and not significantly.

In the private school group, for boys aged 14-18 years the mean calorie-per cent is significantly higher than the mean for boys aged 13-19 in each cultural group in the public school. For each difference between means in the three comparisons P is $< .01$. Differences between the mean calorie-per cents for the private school group and for the public school groups are relatively greater than the differences in the number of calories. This is because the calorie requirements, as shown in Table 2, were higher for the public school boys. Among the public school girls, only for the Jewish group is the mean calorie-per cent significantly lower ($P < .01$) than that for the private school girls.

From the distributions of calorie-per cents for individual diets shown in Table 14, it will be noted that from 67 to 74 per cent of

the boys in the different cultural groups had diets for which the calorie-per cent was from 70 to 129, and from 65 to 70 per cent of the girls had diets within this range, compared with 73 per cent of boys and of girls in the private school. But calorie-per cents 130 or higher are found for only 2 per cent of the Jewish boys, 8 per cent of the Italian, and 6 per cent of the "other" boys in the public school as against 18 per cent of the private school boys. Among girls, calorie-per cents 130 or higher are found almost as frequently for the Italian and "other" groups as for the private school girls, but only 4 per cent of the Jewish girls had a caloric intake 30 per cent or more above requirement as compared with 15 per cent of the private school girls. The frequency of diets which furnished less than 70 per cent of energy need is shown in Figure 4 for both the public and private school pupils. Of the private school boys, 9 per cent had diets for which the calorie-per cent is less than 70 as against 31 per cent of the Jewish boys in the public school, 18 per cent of the Italian boys and 22 per cent of "other" boys. Among girls, diets furnishing less than 70 per cent of calorie need were twice as prevalent for the Jewish group in the public school as for the private school group, 27 per cent as against 13 per cent. Although the calorie-per cent was less than 70 for 15 and 23 per cent of the Italian and "other" girls, respectively, the frequency of such diets is not significantly higher than among the private school girls.

In summary, these data indicate that the Jewish boys and girls in the public school were less well nourished with calories than the other public school pupils in the Study and less well nourished than the pupils in the private school. Boys, but not girls, in the non-Jewish groups in the public school also were less well supplied with calories than the private school pupils.

SUMMARY

Diet histories and records of daily activity for about 300 pupils in a private high school and 2,000 pupils in a public high school in

New York City are analyzed with reference to caloric intake and energy requirement of boys and girls of different ages.

The average calorie requirement for girls determined from individual estimates based on basal energy according to age and surface area and allowances for hours of sleep and of activity at four levels changed very little from ages 12 to 18 years and was close to 2,400 calories daily. The average requirement for boys increased significantly with age from 12 to 16 years and remained about at a level from 16 to 18 years; the minimum average of 2,576 calories daily was for boys aged 12 years in the private school and the maximum of 3,407 calories was for boys 17 years old in the public school. The magnitude of the differences in individual requirements shows clearly that average requirements are unsuitable for an evaluation of the adequacy of individual caloric intake.

The limitations of data from this Study and most surveys for the evaluation of individual intake, even on the basis of individual need and caloric intake, are discussed. Individual variation in basal metabolism, errors in estimates of energy expended, errors in the dietary record, and day-to-day variation in caloric intake make it impossible to identify with certainty the individuals whose consumption levels are adequate or inadequate.

The caloric intake of pupils in the private high school was, on the average, approximately equal to their estimated calorie need. However, for 9 per cent of the boys and 14 per cent of the girls, the calories consumed were less than 70 per cent of the estimates of their requirements, and for 18 per cent of the boys and 13 per cent of the girls consumption was 30 per cent or more above requirements.

Obesity was rather prevalent among the private school pupils. Physicians had rated 12 per cent of the boys and 14 per cent of the girls as either moderately or markedly obese; and 26 per cent of the boys and 23 per cent of the girls were 15 per cent or more overweight by Baldwin-Wood standard weight for age and height. Only 1 per cent of the boys and 2 per cent of the girls were 15 per

cent or more underweight, but 6 and 11 per cent, respectively, were from 7.5 to 15 per cent underweight.

Weight status of the private school pupils and individual caloric intake expressed as a percentage of estimated need (calorie-per cent) showed an inverse relationship. Diets furnishing less than 70 per cent of need were more prevalent among overweight pupils than among underweight pupils, and high-calorie diets were more prevalent among underweight pupils. Causes of this inverse relationship are discussed.

Caloric intake for pupils in the public school, all of whom were from low-income families including some on relief, is given separately for Jewish, Italian and "other" pupils. The mean caloric intake for boys and for girls in the Jewish group was lower than that for corresponding sex-age groups of Italian and "other" pupils, but there was little difference between the caloric level for Italian and "other" pupils. As percentage of individual requirement, for Jewish boys the mean calorie-per cent was 82 and for girls it was 86; for Italians, the mean calorie-per cents were 91 and 98; and for "others" the means were 93 and 97 for boys and girls, respectively.

Boys in each group in the public school had a significantly lower mean calorie-per cent than the private school boys, but only the Jewish girls had a lower mean calorie-per cent than the private school girls.

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