A Review of Teenage Nutrition in the United States

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ADOLESCENCE is a time of rapid physical growth, second only to the prenatal and infancy period in rate. Since calorie and most nutrient needs tend to parallel the growth rate, it is obvious that the adolescent's needs are higher in proportion to body size than those of younger or older people. Needs also decrease as the rate of growth slows.

Is our concern about the food intake of adolescent girls justified? We nutrition educators have spent years telling mothers not to be concerned about the decreased appetites of their children during the second year of life. Do we need to remind ourselves that many girls by the age of 13 have already experienced their most rapid growth and are therefore entitled to a decrease in appetite during the early or middle teen years? In 1932, Wait and Roberts (*1*) in a careful study of the total energy needs of girls aged 10 to 16 years found that calorie requirements rose to a peak just before puberty, at an average age of 13, and then dropped. Eppright and co-workers (*2*) in a study of the diets of school children in Iowa in the early 1950s also found that girls had reached their peak intake at about 12 years. Boys, on the other hand, reached their maximum intake at about 16 years. Heald (*3*) in 1963 confirmed the observation that maximum growth is likely to occur just before puberty and then decline rapidly.

Assessment of Nutritional Status

Traditionally, we use four major kinds of measurements to assess nutritional status: anthropometric, including height, weight, skinfold thickness, and others; biochemical determination of nutrients or metabolites in blood and urine and sometimes other body tissues; clinical assessment, with particular attention to signs and symptoms frequently characteristic of malnutrition; and dietary intake. These various measurements, not one of which is definitive by itself, tend to complement each other; for example, a vitamin C intake of only 5 mg. per day and a plasma serum level of 1 mg. per 100 ml. would indicate that the low ascorbic acid intake was atypical, especially if there were no clinical signs indicative of deficiency.

A combination of the four kinds of measure-

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ments provides information from which we can derive an assessment of the nutritional status of an individual or group. To date we have no definitive methods. There is tremendous need for development of measurements that will tell us what we really want to know, that is, are the body enzyme systems functioning at optimum level for health and well-being? To date we have only a few measures that do this, for example, the measurement of erythrocyte transketolase as an indicator of thiamine nutrition. I hope that my colleagues in biochemistry will devise many other such meaningful measurements. We have been content for too long with time-consuming, costly, and nonspecific methods. Only when we have more efficient methods can we expect more interest in assessment of nutritional status.

Those of us whose focus has been chiefly on the food aspect of nutrition may need to remind ourselves occasionally that food intake by itself cannot spell nutritional health. For this reason dietary intake studies, valuable as they are, are not by themselves a valid measure of nutritional status. "There is many a slip 'twixt the cup and the lip," and also between the lip and the functioning living cell or tissue. The so-called iron-deficiency anemia in teenage girls, for example, does not necessarily indicate a low iron and protein intake. It may be due to other causes. Kruse's 1949 formula (*4*) summarizes the situation:

$$\text{Nutritional status} = \frac{\text{nutrient supply to tissue}}{\text{tissue needs}}.$$

Many physical, social, biological, and psychological factors in addition to food intake affect both the numerator and the denominator of this equation. On the other hand, the importance of food intake must not be underestimated. Certainly nutrients that never enter the mouth will never reach the tissues.

Many dietary studies have omitted biochemical, clinical, and anthropometric measurements. It is not wrong to do this, because such studies may serve a worthwhile educational purpose in teaching teenagers something about nutrient values and desirable nutrient intakes and may provide clues toward possible dietary lacks or excesses that should be verified by other measures. However, they must not be labeled or interpreted as measures of nutritional status.

After calculating the nutrient values of a diet, we usually compare these calculated values with a recommended dietary allowance. We need to re-

member that failure of a group or an individual to meet a certain arbitrary dietary allowance does not necessarily spell malnutrition. The nutrient needs of teenagers vary greatly. The Recommended Dietary Allowances of the Food and Nutrition Board, with which we usually compare such intakes, are clearly labeled as "*goals* for planning food supplies" and "guides for the interpretation of food consumption records of *groups* of people." Obviously, then, each nutrient value in the table should be viewed not as a single value but with a scatter about it as great as the range of needs of the group for whom it is intended, in addition to a safety margin. How large a scatter should be allowed varies with the nutrient. Many nutritionists view these values with a spread of ± 50 percent.

There may be reasons for comparing findings with a food guide, such as the basic four, but the four food groups are not an infallible guide to nutrient adequacy. They may be useful in teaching beginning nutrition. By the teen years, present-day youth is ready for a more sophisticated approach. Furthermore, our present food supply differs vastly from this pattern of four basic groups.

Another point of caution is that the nutrient intake of teenagers varies from day to day. In a

study which my colleagues and I did in Berkeley *(5)*, one boy varied by 4,500 calories from one day to the next! Hence, a short sampling period, such as a 24-hour intake, is not likely to reflect the intake over a period of time, and it is the long-term intake that matters. Chalmers and coworkers *(6)* showed that a 24-hour intake may characterize the nutrient intake of a group. However, persons with deficient or excessive intakes on any one day may well have a different intake on the next day. Thus, even though the group profile may not change, that of individuals may. Alarming reports on the nutritional state of the American teenager can and have resulted from mislabeling and misinterpreting dietary studies.

Study Findings

To date there has been no nationwide study of the nutritional status of a statistically valid sampling of American youth. The first of these is now in progress under the sponsorship of the National Center for Health Statistics. It is the Health and Nutrition Examination Survey—sometimes called HANES. The plan is to maintain surveillance of the health and nutrition of the American people by examining a national probability sample of the civilian, noninstitutional population aged 1 through 74 years, every 2 years.

The preliminary report of the Ten-State Nutrition Survey, completed under the guidance of Dr. Arnold Schaeffer, has recently been published *(7)*. Sampling for this study was planned to include primarily the low-income population. So far only hemoglobin levels, serum values for vitamins A and C, and urinary riboflavin excretion levels have been reported. The ranges among the 10 States in the percentage of teenagers found to be "deficient" and "low" in these nutrients are shown below. The tremendous differences among States, particularly when "low" and "deficient" were grouped together, should caution us against overgeneralization.

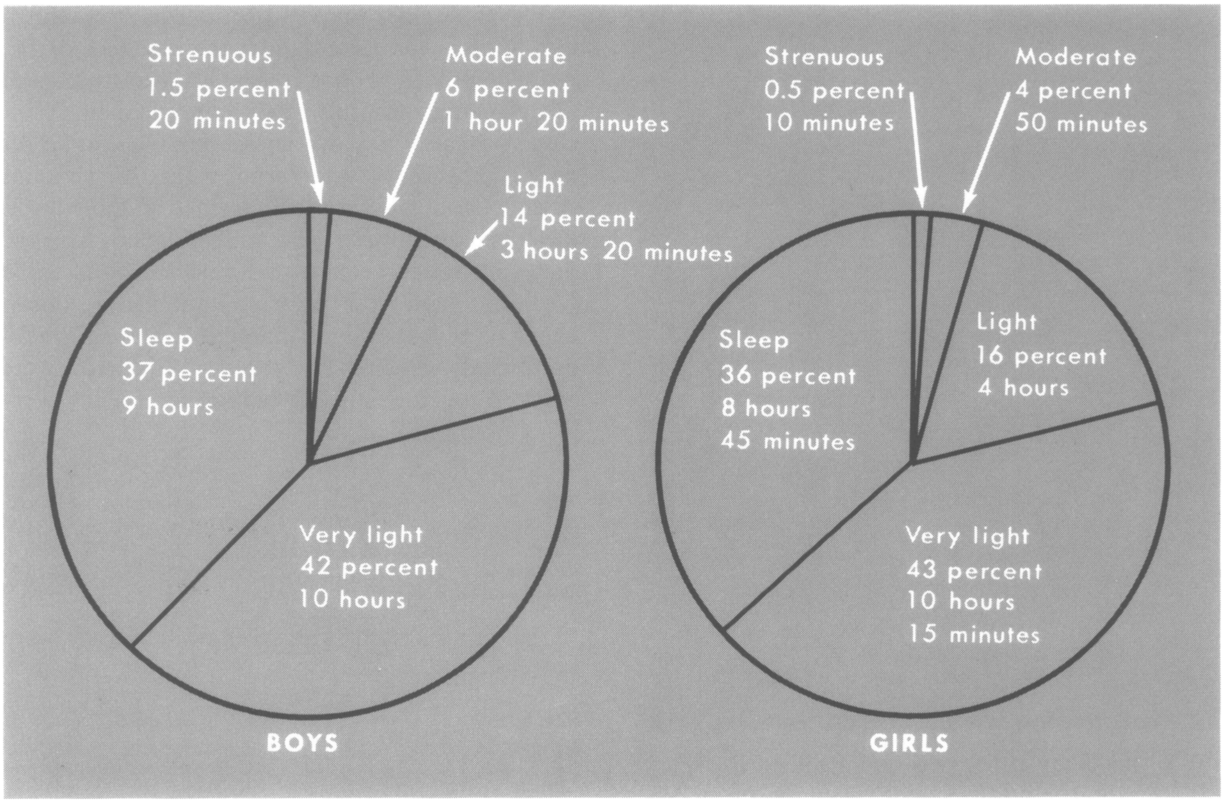
Nutrient	*Deficient*	*Deficient and low*
Hemoglobin	0.5–2.9	6.3–31.0
Vitamin A	.0–6.0	2.6–26.6
Vitamin C	.0–2.7	.5–13.0
Riboflavin	.0–5.9	2.7–30.9

The criteria used in the Ten-State Survey were as follows:

Hemoglobin	*Levels*
Deficient:	
6–12 years	< 10.0 gm. per 100 ml.
13–16 years, male	< 12.0 gm. per 100 ml.
13–16 years, female	< 10.0 gm. per 100 ml.
Low:	
6–12 years	< 11.5 gm. per 100 ml.
13–16 years, male	< 13.0 gm. per 100 ml.
13–16 years, female	< 11.5 gm. per 100 ml.
Vitamin A	*Serum values*
Deficient	< 10 mcg. per 100 ml.
Low	10–19 mcg. per 100 ml.
Vitamin C	
Deficient	< 0.1 mg. per 100 ml.
Low	0.1–0.19 mg. per 100 ml.
Riboflavin	*Levels in urine*
Deficient	<70 mcg. per gm. creatinine.
Low	70–199 mcg. per gm. creatinine.

The 1965 Household Food Consumption Survey of the Department of Agriculture included assessment of the food intake of certain groups of people *(8)*. Approximately 1,400 boys and girls aged 12 to 19 years inclusive reported their food intake for the preceding 24-hour period to a trained interviewer. The mean caloric intake for the boys was highest in the age group 18 through 19 years (3,049), but only slightly higher than that of those aged 15 to 17 (2,989). As in studies previously cited, the girls aged 12 to 14 years consumed the most calories (2,146). (The spread around these figures is not given in the preliminary report.) For the boys, average intakes met or

Percentage and amount of time spent daily in different classes of activity by 127 teenagers



slightly exceeded the recommended dietary allowances. The girls' mean iron intake was about 11 mg., definitely less than the recent recommended allowance of 18 mg. Vitamin A and thiamine were also slightly below recommended amounts. Obviously, some intakes must have been below the mean.

No other studies have been made of teenagers for the United States as a whole. Numerous studies have been made of smaller groups. Hodges and Krehl in 1965 (*9*) published some of the findings of a study of a statistically valid sampling of Iowa children in grades 9 through 12. Again, mean values both for nutrient intake and biochemical measurements met usually accepted levels of adequacy, but a small proportion was low in hemoglobin and vitamins A and C blood levels. Calorie and protein intakes appeared to be more than adequate.

In a longitudinal study of 127 teenagers in Berkeley, Calif., on the basis of four 7-day dietary records, Hampton and co-workers (*5*) found that even though mean intakes of all nutrients except iron and calcium met or exceeded the recommended dietary allowances, 15 percent of the girls failed to meet two-thirds of these allowances for

Prevalence of "obesity" among 127 teenagers in a longitudinal study, Berkeley, Calif., by grade in school

Obesity	9th grade		10th grade		11th grade		12th grade	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Boys:								
Mild, 20 percent body fat......	23	5	25	6	44	9	37	9
Marked, 25 percent body fat...	27	6	29	7	22	5	20	5
Girls:								
Mild, 25 percent body fat......	41	8	42	9	42	10	41	10
Marked, 30 percent body fat....	16	3	17	3	27	7	16	4

SOURCE: reference 5.

vitamins A and C, while 10 percent of the boys failed to meet this level for vitamin A and 30 percent for vitamin C. There were no really "low" protein intakes, but approximately half of the girls were "low" in iron and calcium (less than two-thirds the recommended allowance). Even though roughly 10 percent of both boys and girls consumed less than two-thirds the allowance for calories, obesity was not uncommon, as indicated in the table.

In part, this obesity could be accounted for on the basis of inactivity. Despite "busyness" and crowded schedules, the boys and girls studied were extremely inactive, as shown in the chart. My colleagues and I believe that such inactivity is not uncommon today and that this, rather than eating huge amounts of food, is responsible for much of the obesity we see. Reports of numerous studies have documented the observation that the obese do not necessarily eat more than their leaner peers (*10–14*).

Wharton (*15*) studied teenagers in three high schools in southern Illinois on the basis of 3-day diet records. He reported generally lower nutrient intakes than in the Berkeley study and a far higher proportion of both boys and girls who failed to meet two-thirds of the recommended allowances.

The earlier studies of teenagers in eight States during 1947–58, under the auspices of the agricultural experiment stations and summarized by Morgan (*16*), showed similar variation from one locale to another. Generalization is therefore difficult. Iron intakes of girls, however, were commonly low, and some groups and individuals had low intakes and low blood levels of vitamins A and C. Low intakes of calcium were also fairly common.

It is common knowledge that dental caries are highly prevalent among teenagers. In this connection, even though the U.S. overall caloric consumption has decreased over the years, the sugar consumption has increased and now stands at about 100 pounds per person per year. Fluoridation of water supplies is also not yet a universal achievement. Other problems include diabetes, inborn errors of metabolism, hypertension, and atherosclerosis.

Reports on the effects of teenage pregnancy, the "pill," and drug abuse on nutrition are just beginning to appear. A recent article by Hodges (*17*) makes an interesting comparison between the nutritional effects of oral contraception and normal pregnancy.

Of importance for nutrition education programs are the numerous studies on teenagers' values and attitudes toward health, nutrition, and food and eating practices. Space does not allow a review of them here, but there is ample evidence that teenagers are interested in their body size, shape, and development and in their eating practices.

Conclusions and Recommendations

Based on the evidence available to date, (*a*) we have no information on the nutritional status of American teenagers as a whole and (*b*) studies of groups indicate tremendous variation in measures of nutritional status and tend to support the view that an unknown proportion of the teenage population has nutritional problems. The major problems appear to be dental caries, obesity, and anemia in girls and in some boys. Less than desirable levels of vitamins A and C have been found in some teenagers. Calcium intakes are frequently low, especially in girls. Individuals and groups in less than desirable nutritional status need to be identified and sought out for nutritional help. Nutritional status in regard to the trace minerals and the "newer" vitamins, such as pyridoxine and pantothenic acid, has not been assessed.

Finally, there are considerations that probably outweigh all of those I have tried to summarize from the literature. The first of these is that our lifestyle is changing more rapidly than we, as educators, have changed our approach. One major change is in our food supply. More and more we buy already prepared or partially prepared convenience foods and manufactured foods, such as the soybean "meat" products. Laboratory-made nutrients are being added to foods. All these changes have tremendous potential for improving the American diet, but they also necessitate changes in our educational approach. The following are some educational changes which I recommend.

1. We must be aware of a far wider range of nutrients than the traditional eight or nine. The so-called "lesser" nutrients will not "take care of themselves" in a manufactured product as they do in natural foods. The 1968 recommended dietary allowances include some of the lesser nutrients, and we need to learn more about them and to find ways of imparting knowledge of them to teenagers.

2. We must obviously teach in nutrient terms. Food groupings alone will not do.

3. We must be more intent than ever on insisting on proper labeling and then teaching teenagers to read and interpret labels. Proper labeling will obviously require far more emphasis on food analysis than we are now giving this activity.

4. The consumer must no longer be the only target for nutrition education. We must learn to communicate with food technologists, food manufacturers and processors, advertisers, and legislators in order to influence teenage nutrition.

A second major change is in our eating practices. Most teenagers and adults eat more than three times a day. Many people, in fact, rarely eat regular meals. We found this to be true of one-third of our teenage subjects as long ago as 1961 (*7*). Yet many home economics foods courses are still geared primarily to preparation of breakfasts, lunches, and dinners. Obviously, a change to regular meals would necessitate a change in the entire way of life of many children and their families. Is this an essential and realistic goal for nutrition educators? Another change is that more and more meals are being eaten away from home. I am pleased to see that many high school courses are recognizing this fact.

A third major change is in the teenagers themselves, and this is doubtless the most important change of all. A large proportion of them—unfortunately not all—have far better science training at the grade school level than ever before. We must not underestimate their ability to learn and understand technical nutrition. On the other hand, there is also a counter-culture reaching down from colleges into high schools which rejects the findings of science and emphasizes the use of "natural" foods, "organic" vegetables, and so on. My only answer on how to deal with this problem is that we must approach this culture just as we would any other that is foreign to us, that is, with sympathetic understanding. A recent article by Erhard (*8*) in the Journal of Nutrition Education may give us some clues.

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HUENEMANN, RUTH L. (University of California, Berkeley): ***A review of teenage nutrition in the United States. Health Services Reports, Vol, 87, November 1972, pp. 823–829.***

Since adolescence is a time of rapid physical growth, nutrient needs in relation to body size are higher than those of younger or older people. Caloric needs rise to a peak just before puberty and then drop. Girls usually reach their peak intake at 12 to 13 years of age and boys at about 16.

Nutritional status can be derived from four types of assessment: anthropometric, biochemical, clinical, and dietary. There is need for the development of specific measurements of nutrient functioning, such as the erythrocyte transketolase determination for thiamine nutrition.

To date there has been no nationwide study of the nutritional status of a statistically valid sample of American youth. The first of these is now in progress under the sponsorship of the National Center for Health Statistics. Evidence available to date indicates that dental caries, obesity, anemia in girls and in some boys, and less than desirable intakes of calcium, iron, and vitamins A and C are not uncommon. Status in regard to the trace minerals and the "newer" vitamins, such as pyridoxine and pantothenic acid, has not been assessed. Other matters for concern include the existence of a youthful counter-culture with its rejection of the findings of science and of a highly developed food technology that may be indifferent to nutritional considerations.