Consideration of Adolescent Obesity As a Public Health Problem

RUTH L. HUENEMANN, D.Sc.

MEASURES to control obesity in adolescents involve its prevalence, effect on health, and associated factors.

Prevalence

Researchers are bound by the lack of consensus about what constitutes obesity and how to assess it and the paucity of data about its prevalence in the United States by any definition.

The common definition of obesity as a state characterized by excess body fat helps to distinguish obesity from overweight, which is simply weight above the average of a given population.

The onset of obesity is sometimes defined as that point at which proliferation of adipose tissue cells begins. Unfortunately we have no easy, quick field method for assessing this point. Various techniques are being used to approximate the ratio of bone to muscle to fat, or fat to nonfat, or the minimal essential to nonessential fat composition of the living human body. These include specific gravity by underwater weighing or helium displacement, determination of the body's radioactive phosphorus content by a whole-body counter (K_{40} determinations), X-rays to measure the thickness of gross body components, and measurements of various body circumferences and bony diameters. Other workers are attempting to measure degree of obesity by measuring the thickness of subcutaneous fat at various body sites by means of calipers, ultrasonic techniques, or electrical conductivity.

While data from one study may not be strictly comparable to those from another, obesity in this paper is defined in the terms used to define it in the studies reported.

Regional nutritional status studies. During 1947–58 more than 200 studies were carried on by agricultural experiment stations, the Institute of Home Economics of the U.S. Department of Agriculture, and some State health departments. These studies concerned aspects of nutritional status of various age groups.

Adolescents were studied in New Mexico, Montana, Idaho, Washington, and Iowa. The Iowa studies showed that of 280 boys aged 12–18 years, 12 percent were in channels A_3, A_4, and higher of the Wetzel grid (*1*). Of 276 girls aged 12–18, 23 percent were in A_3 and A_4. Fifteen percent were in channel A_4 and higher. Of the 275 persons in the Idaho study of 15- and 16-year-olds, 12 percent of the girls and 9 percent of the boys were in A_4 and higher (*2*). Findings of the Montana and Washington studies (*3*) were similar to those in Idaho. In the New Mexico study of 14-, 15-, and 16-year-olds, 108 of the 178 subjects were Spanish American.

Dr. Huenemann is professor of public health nutrition, University of California School of Public Health, Berkeley. *This paper is based on a speech given at the 95th annual meeting of the American Public Health Association, Miami Beach, Fla.*

None of the Spanish American boys were in A_4 channel or above, compared to 7 percent of the white boys; 3 percent of the Spanish American girls were in A_4 or above, compared to 10 percent of the white girls (*3*). (The upper physique channels A_4, A_3, and A_2 include children of heavy, stocky build; the middle channels, A, M_1, and B_1, children of more nearly average build; and the lower channels, B_2, B_3, and B_4, thinner, lighter children.)

Valuable as these studies were in calling attention to nutritional status, the findings may not be valid now. In addition, they are not really prevalence studies, and subjects were not necessarily representative of the population of their State.

Iowa studies. Hinton (*4*) found that by dividing subjects by weight for age into seven groups, using the physical growth record for girls prepared by the joint committee on health problems in education of the National Education Association and the American Medical Association, 18.6 percent of 140 subjects aged 12, 13, and 14 years fell into the upper two categories of heavy or very heavy.

Hodges and Krehl (*5*) drew a random sample of large, medium, and small high schools in Iowa. Two-thirds of the children in each grade, from 500 to 600 in grades 9, 10, and 11 and 350 in grade 12, were accepted for study. Heights and weights were greater than those in the University of Iowa tables for 1940. Mean values were as follows.

Measure	*Boys*	*Girls*
Height (in.)	67.9± 3	64.6± 2.5
Weight (lb.)	145.0±25	126.1±18.6
Arm skinfold (mm.)	14.0± 7	16.0± 5.5
Scapular skinfold (mm.)	12.4± 7	13.6± 6.1

Anthropometric nutrition study. The Berkeley anthropometric nutrition study of body composition and associated factors of adolescents was designed to gather information for planning programs of obesity prevention and physical fitness (*6*). The subjects were 1,000 teenagers, an entire grade of the public high school system in Berkeley, Calif. Ten percent of these subjects were Oriental, 30 percent were Negro, and the rest were chiefly white. The staff of the Berkeley study determined body composition by the body envelope method of Behnke, measuring 11 body circumferences and six diameters. Data were gathered on these students when they were in the ninth grade and continued until they were in the 12th. For boys, mild obesity was defined as 20 percent body fat and marked obesity as 25 percent body fat or more. For girls, mild obesity was defined as 25 percent body fat and marked obesity as 30 percent body fat or more. Following are percentages of subjects found to be obese.

Subject	*Grade*			
	Ninth	*Tenth*	*Eleventh*	*Twelfth*
Boys:				
Mild obesity	5	6	9	9
Marked obesity	6	7	5	5
Girls:				
Mild obesity	8	9	10	10
Marked obesity	3	3	7	4

On the basis of the scanty evidence of these studies, between 10 and 15 percent of the adolescent population are obese. This is enough for concern.

Traits of obese teenagers. Obese boys in Berkeley tended to be the tallest in their age groups, especially in the ninth grade (*7*). Differences in height became progressively less marked in the next 3 years. Obese girls tended to be short and stocky and to mature early as indicated by age of menarche. The hip width to height ratio was larger for both sexes and all three races for the obese than the nonobese. Absolute values varied with race, however, and Negroes had proportionately narrower hips than the other races.

Seltzer observed that "obese adolescent girls appear to be more endomorphic, somewhat more mesomorphic, and considerably less ectomorphic than the nonobese girls of comparable age"(*8*). Thus a genetic component is implied.

On the basis of K_{40} measurements on 15 boys and 12 girls aged 8–18 years, Forbes suggested two kinds of obesity in children (*9*). The first is characterized by an increase in lean body mass as well as fat; the second is due to fat only. Subjects in the first group tend to be tall, have advanced bone age, and have been obese since infancy. The second group are of normal height, have less accelerated bone age, and become obese in mid- or late-childhood.

The Berkeley study found proportionately more Negroes than whites or Orientals who

were obese. There was less difference between the two races among 12th grade girls (*6*).

As found in other studies the lower socioeconomic group in Berkeley had a higher prevalence of obesity, whether socioeconomic status was measured by census tract income or education and employment ratings of parents.

For the most part children became obese before teenage. Only six boys and 12 girls of the 114 obese youngsters in the 12th grade were not already so classified in the ninth grade (*6*).

Effect of Adolescent Obesity on Health

A retrospective study was made in Hagerstown, Md., by the Public Health Service to see whether obesity in childhood is associated in adult life with higher levels of blood sugar, serum cholesterol, and with an increased morbidity or mortality from cardiovascular disease (*10*). Subjects were white boys in elementary schools in Hagerstown from 1923 to 1928 in the age group 9–13 years. There were 1,963 persons whose heights and weights were available from school records. Of these, 717 were examined 35–40 years later.

Weight status was determined using relative weight defined as the percentage deviation of actual weight from average weight for a given sex, age, and height. Normal weight values during childhood were obtained from the Baldwin-Wood height-weight tables. The distribution of relative weights was arbitrarily divided into four categories which consisted of underweight—ranging up to 95 pounds, average weight—95–104 pounds, moderately overweight—105–119 pounds, and markedly overweight—120 pounds and over.

Researchers found that the childhood weight pattern tended to persist into adult life, that there was a significant relationship between adult fasting blood sugar and marked overweight in childhood, and that there was no relationship between childhood weight and adult cholesterol or serum beta lipoproteins or blood pressure. They also found higher rates of clinical arteriosclerotic heart disease, hypertensive vascular disease, and all cardiovascular renal diseases, diabetes, and clinical obesity among persons who had been markedly overweight in childhood.

In reassessing the association of degree of overweight as given in actuarial tables of the Metropolitan Life Insurance Company with mortality from cardiovascular disease, Selzer found these associations held only in cases of marked obesity (*11*).

Perhaps we are too concerned about mild obesity. We must establish norms compatible with health rather than with the whims of fashion.

In a group of 11- to 21-year-olds studied by Selzer and Mayer (*12*), 25 boys and 32 girls were obese (A_4 or higher on the Wetzel grid); 135 boys and 129 girls were nonobese. Thirty-two percent of the obese boys had serum iron values below 75 μg. per 100 ml. and unsatisfactory iron binding capacity (above 300 μg. per 100 ml.), while this was true of only 13 percent of nonobese boys. These findings also held for 25 percent of the obese girls, but only 15 percent of the nonobese girls (*12*).

In the Berkeley study the investigative staff found, as had Eppright (*1*), that obese girls tended to have a lower nutrient (protein, mineral, and vitamin) intake than those of normal weight (*13*). A subsample of 122 subjects from all body fat classes kept four 7-day food and activity records. The average intakes of all nutrients except iron and calcium for girls compared favorably with the recommended dietary allowances of the Food and Nutrition Board of the National Research Council. Protein, vitamin A, riboflavin, niacin, and ascorbic acid exceeded these allowances by a considerable margin.

Averages may, however, be misleading, for there was considerable spread around that mean. Only 10–20 percent of the boys were low in any nutrient except vitamin C; 30 percent fell below the two-thirds level of the recommended allowances for vitamin C. About half of the girls were lower than two-thirds of the recommended allowance in calcium and iron; of the obese, two-thirds were low in iron.

Other Factors Associated with Obesity

Johnson and co-workers first emphasized that the obese do not necessarily eat more than the nonobese (*14*). They found a mean daily intake of 1,965 calories for the obese compared to 2,700 calories daily for nonobese girls in the control

group. However, Eppright (*1*) did not find that the obese ate fewer calories than nonobese.

In the Berkeley study the boys as a group averaged about 2,800 calories per day, on the basis of four 7-day records (*13*). The obese averaged about 2,600, as did the lean, and those of average weight about 3,200. Girls averaged about 2,000 calories per day; obese girls averaged about 1,700 calories daily. We found great variation between persons and from day to day and week to week for all body fat classes. In summer of 1963 boys averaged a difference of 2,200 calories from the lowest to the highest day. The boy with the least variation varied by 635 calories; the one with the most varied by 4,700 calories. The girls averaged a difference of 1,700 calories—from 650 calories to 6,000 calories. The average week-to-week variation was 900 calories per day for boys and 700 calories per day for girls.

Snacking was common to all body-fat classes and ethnic and socioeconomic groups (*14*). Snacks generally augmented the protein, mineral, and vitamin intake.

Eating frequency averaged four to five times per day. The obese tended to eat less frequently and omitted breakfast and lunch more often. Many subjects ate irregularly. Only 10 percent of Negro boys and 30 percent of Negro girls followed any regular pattern of eating. The Berkeley study group has not determined if we should continue to teach meal patterns or should work toward nutritious snacks and convenience foods. It is true that those who ate regularly and with their families had higher nutrient intakes.

The obese ate fewer fruits and vegetables and drank less milk than the nonobese. Obese boys ate more sweets than average, but obese girls did not. The main caloric contributors for all boys were meat, dairy products, cereal products, and desserts and sweets; for all girls they were dairy products, meat, desserts and sweets, and cereal products. These findings indicate that public health workers need not encourage increased meat consumption. We might, in fact, urge people to cut down on portion size.

Johnson and co-workers (*15*) found that the obese tend to be less active. Our Berkeley gross measurement of activity was probably not adequate to distinguish individual differences, especially in a group that varied in body composition, size, and rate of growth. We did, however, identify general patterns of activity. The girls averaged more than 95 percent of their time in sleeping, very light, and light activity, while the boys averaged more than 90 percent of their time in these activities. Both boys and girls averaged about 80 percent of their time in sitting or lying down, yet they viewed themselves as active. We have no reason to expect that these teenagers will become more active as they grow older.

Of 26 boys and 91 girls who reported they were dieting to lose weight in the ninth grade, five boys and 14 girls had less body fat in the 12th grade. Three boys and 14 girls had more body fat in the 12th grade (*16*).

Conclusions

We need more prevalence data to find out if adolescent obesity is a nutrition problem in the United States. The scanty information available indicates that 10–15 percent of the teenage population is obese.

The adverse effects of obesity on health are indicated by several studies. We must establish norms compatible with health rather than with the whims of fashion.

Since treatment of obesity is difficult and not often effective, we should emphasize prevention. Preventive measures must recognize present ways of living, such as snacks and convenience foods which are prepared outside the home for the most part, and ways of energy expenditure compatible with modern life.

There is indication that certain persons and members of groups are particularly vulnerable to obesity. While special efforts should be directed toward identifying and working with these persons, it seems wise to work with the general population toward a cultural change to decrease energy intake and to increase energy expenditure.

REFERENCES

(*1*) Eppright, E. S.: Food intake and body size of Iowa children. *In* Weight control. Iowa State College Press, 1955, ch. 9, pp. 119–131.

(*2*) Warnick, K., et al.: Nutritional status of school children 15 and 16 years of age in three Idaho communities. University of Idaho Agricultural Experiment Station Research Bulletin No. 33, 1956.

(3) Morgan, A. F., editor: Nutritional status U.S.A. California Agricultural Experiment Station Bulletin 769, October 1959.
(4) Hinton, M.: Factors related to the eating behavior and dietary adequacy of girls 12 to 14 years of age. Dissertation. Iowa State University, Ames, 1962.
(5) Hodges, R. E., and Krehl, W. A.: Nutritional status of teenagers in Iowa. Amer J Clin Nutr 17: 200, October 1965.
(6) Huenemann, R. L., et al.: Adolescent food practices associated with obesity. Fed Proc 25: 4, January–February 1966.
(7) Hampton, M. C., et al.: A longitudinal study of gross body composition and body conformation and their association with food and activity in a teen-age population: Anthropometric evaluation of body build. Amer J Clin Nutr 19: 422, December 1966.
(8) Selzer, C. C.: Body build and obesity—who are the obese? JAMA 189: 677, Aug. 31, 1964.
(9) Forbes, G. B.: Lean body mass and fat in obese children. Pediatrics 34: 308, September 1964.
(10) McDonaugh, J. R., Abraham, S., and Collins, G.: Childhood obesity in relation to adult morbidity and premature mortality. U.S. Public Health Service, Washington, D.C., July 1964. Mimeographed.
(11) Selzer, C. C.: Some re-evaluations of the build and blood pressure study, 1959, as related to ponderal index, somatotype and mortality. New Eng J Med 274: 254, Feb. 3, 1966.
(12) Selzer, C. C., and Mayer, J.: Serum iron and iron-binding capacity in adolescents. Amer J Clin Nutr 13: 354, December 1963.
(13) Hampton, M. C., et al.: Caloric and nutrient intakes of teenagers. J Amer Diet Assoc 50: 385, May 1967.
(14) Huenemann, R. L., et al.: Food and eating practices of teen-agers. J Amer Diet Assoc. In press.
(15) Johnson, M. L., Burke, B. S., and Mayer, J.: The obese high school girl. Amer J Clin Nutr 4: 37 (1956).
(16) Huenemann, R. L., et al.: A longitudinal study of gross body composition and body conformation and their association with food and activity in a teen-age population: Views of teen-age subjects on body conformation, food and activity. Amer J Clin Nutr 18: 325, May 1966.

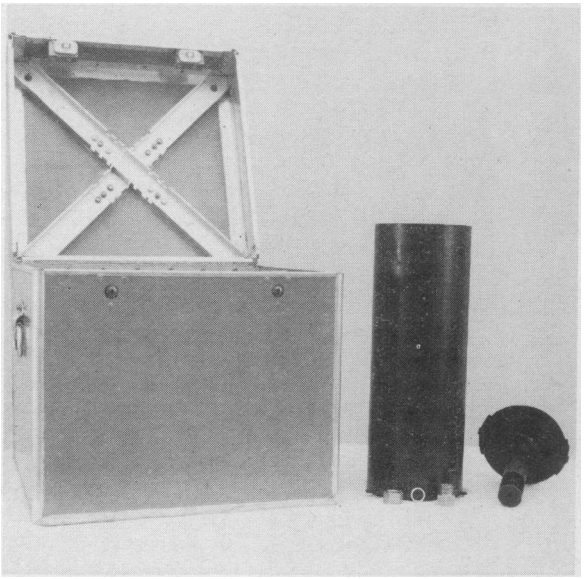
Joint Project To Evaluate Radon Emissions From Uranium Tailings

Technical assistance to States and industry in evaluating public health implications of emissions of radon, a radioactive gas, from uranium mill tailings piles is a joint project of the Public Health Service and the U.S. Atomic Energy Commission.

The Service's National Center for Radiological Health and National Center for Air Pollution Control and the Atomic Energy Commission's Division of Operational Safety are responsible for the overall direction of the radon project. Surveys and evaluation of findings are being made by the Radiological Health Center's Southwestern Radiological Health Laboratory in Las Vegas, Nev., and the Commission's laboratory in Idaho Falls, in cooperation with the States involved.

The project includes (*a*) development of techniques for sampling air for radon content in the vicinity of uranium tailings, (*b*) determination of the effect on radon emissions when tailings are covered with earth or paving material, (*c*) evaluation of atmospheric concentrations near tailings piles as a first step to develop an index of population exposure, and (*d*) preparation, if necessary, of recommendations for the control of radon exposure.

Shipping Container for Radium



The National Center for Radiological Health of the Public Health Service has developed a container which prevents radium losses during shipment as a means of eliminating a cause of environmental contamination by radiation.

Radium needles and capsules, no more than a half-inch long and an eighth of an inch thick, can be seriously harmful to health unless properly used by a physician or qualified professional. One needle may cause radiation burns if picked up by a person, unaware of the hazard, and carried for several hours. Moreover, these sealed radium sources, when not properly packaged, can be broken. This, in turn, can spread radioactivity with its threat of short term or delayed health effects over relatively large areas through the release of the encapsulated radium salts.

The shipping container, pictured, is reusable. It has been designed specifically for medical radium capsules and needles in the commonly used sizes. It may be adapted readily, however, for radium-beryllium neutron sources and may be modified to provide a container for plaques and nasopharnygeal applicators.

The container is an interlocking of interior and exterior containers. These cannot be closed until one has been fastened to the other so that there can be no internal movement or accidental opening during shipment.

The interior container is in three sizes, each made to hold a maximum of 50, 150, or 300 milligrams of radium. Each size is fabricated in two parts of threaded hexagon brass stock with bottom portions drilled to receive a limited number of radium capsules or needles of a given size. Bottoms and tops are tightened against a metal gasket to prevent leakage of radioactive gas which could occur with leaking radium needles or capsules.

The interior container is also locked into the center of a cylindrical lead-lined shield by a plug-shaped closure and held by a spring-loaded device. The plug may be inserted and locked into the shield by a spring-loaded bayonet type lock, but only if the interior container has been properly positioned in the plug and is of a size suitable for a given shield.

The interlocked interior container and shield are secured in the center of the exterior container by inserting the shield into slotted channels built diagonally in the bottom and top of the container. The upper channels are so aligned that the exterior container may not be closed unless the shield closure is in a fully locked position. The exterior container, an 18-inch cube constructed of one-quarter inch plywood and metal corner moldings, is sized to meet, with a minimum amount of lead shielding, the dose rate requirements of transportation agencies.