

DOCUMENT RESUME

ED 139 784

SP 011 085

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 TITLE Obesity, Physical Activity - Children.  
 PUB DATE 76  
 NOTE 8p.; Paper presented at American Alliance for Health, Physical Education, and Recreation Convention (Detroit, Michigan, November 1976)

EDRS PRICE MF-\$0.83 HC-\$1.67 Plus Postage.  
 DESCRIPTORS \*Body Weight; Cardiovascular System; Children; \*Exercise (Physiology); \*Growth Patterns; Lifestyle; Physical Characteristics; \*Physical Development; Physical Education; Physical Fitness; \*Special Health Problems  
 IDENTIFIERS \*Obesity

ABSTRACT

Childhood obesity starts at a very early age, and preventive measures taken early enough may retard the development of fat cells. It appears that physical activity plays an important role in reducing obesity. The activity program must start early, in preschool days. It is felt that screening children for obesity when they first enter school and providing a good physical activity program are major steps towards reducing the obesity problem. (JD)

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OBESITY, PHYSICAL ACTIVITY - CHILDREN

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Recent studies conducted on a large number of subjects suggested there are two types of obesity: one wherein the subject has too many fat cells and would be said to be suffering from "hyperplastic obesity," and the other wherein the subject has fat cells that are too large, a condition called "hypertrophic obesity." It appears that the early onset (childhood) obesity is primarily hyperplastic, whereas late-onset (adult) obesity is hypertrophic. However, these conditions may overlap.

A study by Knittle involving obese and nonobese children showed at all ages studied, obese children had larger fat cells and also a greater number of fat cells than the nonobese child. These differences were observed as early as age 2. He also stated that a rapid increase in fat cellular content begins between the ages of 5 and 7 years or earlier for the obese, whereas in nonobese children a similar occurrence does not occur until the ages of 8 to 12. After the age of two there is a rapid proliferation of cells without enlargement in obese subjects that continues until about age 12 to 16. ~~Nonobese subjects do not have significant~~ increases in total fat until the age of 10 and then the increase is accomplished by changes in both cell size and cell number.

Knittle also studied the effects of weight loss (dietary restriction) on fat cell content in obese children. At all ages studied (i.e. ages 2, 5, 6, 11, 13, 18 years) decreases in body fat were accomplished by a reduction of fat cell size without significant changes in cell number. Thus he concluded that once a particular number of fat cells is achieved, irrespective of age, one cannot decrease their fat cell number by dietary restriction. Furthermore, other studies involving obese children under the age of 6, whose fat cell number had not exceeded adult values, indicate

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that one might be able to alter or retard the rate of fat cell development if obesity is detected at a very early age.

#### HOW IS OBESITY DETERMINED

Several methods have been used to determine obesity in children.

The first method is hydrostatic weighing or underwater weighing. It involves determining the child's weight underwater in which his/her total body volume can be calculated. From this, body density is determined and then using an appropriate equation, percent body fat can be calculated. Even though this method is considered the most accurate technique for determining body fat, it should be noted that some error may occur due to incomplete bone ossification in children which will effect the overall body density.

Another method involves radiating potassium through the body. Since lean body weight picks up the potassium and fat cells do not, the potassium that passes through the body relative to the initial volume radiated and picked-up on a counter will yield the percent fat tissue.

Other methods involve the use of skinfold measures, growth body weight charts and circumference measures. These are indirect methods since they must be applied to regression equations to determine percent fat. Thus, the percent fat error is slightly greater than the first two methods described. Later on in my talk I will show you how to determine the percent fat in children using circumference measures.

#### WHAT ARE THE STANDARDS FOR OBESITY

Unfortunately, obesity standards for children have not been established. In adult men and women, obesity can be defined according to Behnke as the accumulation of body fat greater than 20 percent and 30 percent of total body weight for men and women, respectively.

Studies by Wilmore and Gilliam using underwater weighing used greater than 25 percent body fat as the obesity standard for children 7 to 12 years of age. Laurer computed relative weights on 4,829 children as a percentage above or below the median weight for all subjects with the same height, age and sex. He defined obesity as a relative weight greater than 110 percent. Other studies using the skinfold technique defined obesity as those children whose tricep skinfold thickness measures fell in the 85th percentile or higher. Regardless of the technique employed more data is needed to establish an obesity standard specific to age and sex. This is necessary since Garn has shown that any single indirect overweight measure, whether it be relative weight or another single or multi-dimensional estimate such as tricep skinfold, does not define obesity equally well in infants, in pre-school children, in school age girls and in adolescents.

To compound the establishment of obesity standards for children even further is what can be called a growth problem. During the adolescent growth spurt in children, of which there are great individual differences in age of onset and degree of growth, almost all organs participate in the general increase in size. Prior to mid-adolescence there is little difference in height, weight and degree of leanness between sexes. However, during the adolescent growth spurt, as size increases, there is a sharp sex-related difference in the amount of fat mass that is deposited. Aside from essential amounts of fat, which have been estimated to be between 2-3 percent of total body weight, females will acquire sex-specific fat amounting to 8 to 10 percent of total body weight. Thus independent of storage fat which is probably not sex-related, females by late adolescence and early adulthood will have acquired 9-12 percent more fat than their male counterparts.

## WHY THE CONCERN ABOUT OBESITY

Recent studies, including one from our laboratory, have shown that certain Coronary Heart Disease (CHD) risk factors are prevalent in children. One of these risk factors identified is obesity. Wilmore, studying the predominance of CHD risk factors in 95 boys ages 7-12, found that 36 percent of these boys were obese. Laurer reported 23 percent of the 4829 school age children were also obese. Data from our laboratory shows that 23 percent of the 111 boys and girls ages 6-13 studied are obese. More importantly though, our data shows that triglyceride levels are significantly higher in obese children than in non-obese children.

Furthermore, obese children have less tolerance to heat. Thus when performing physical activity in a hot, humid environment they are more susceptible to heat disorders (i.e., heat exhaustion, heat stroke).

## OBESITY PREVENTION

Early detection or screening for obesity is absolutely essential. Part of the screening program should involve family interviews. By meeting the mother, father and siblings of the child, one can gain some insight of what is to come. Garn has shown that fatness runs along family lines comparing parents with their children. Fat parents do tend to have fat children and lean parents tend to have lean children. According to Garn when both parents are obese, their children become fatter and fatter until by age 17 they are actually three times as fat as children of the doubly lean. Garn also reported obese children

tend to be taller than non-obese children as well as having a more advanced skeletal age. Our data shows a mean height of 138.1 cm (n=86) for the non-obese children and a mean height of 145.1 cm (n=22) for the obese children. Thus any systematic approach toward reducing the level of fatness by caloric restriction may also result in a slowing of growth and a smaller (final) adult size. Hence, if caloric restriction is prescribed from infancy onward as an approach to control obesity, Garn feels that one should be aware of these developmental and maturational implications.

According to Mayer and Parizkova physical activity plays an important role in influencing body composition. Mayer found that most of the extra weight gain in obese children seemed to take place in the fall and winter but not the summer which seemed to follow a pattern of less activity in the winter and more in the summer. He also noted that obese girls actually consumed 300-400 calories less per day than thin girls. The difference in body composition between the obese and thin girls was related to their level of physical activity. In fact, a film analysis of their physical activity patterns showed that the non-obese (thin) girls were much more active than the obese girls. In another study, Mayer worked with several hundred obese children increasing their daily physical activity to one hour per day, five days a week. After several years, 60 percent of the children lost weight. Mayer also noted that psychologically the obese child often feels rejected. This obviously tends to make the child more isolated, more unhappy and thus more and more inactive.

Parizkova has found that children who are active tend to have less fat and more lean body mass than those who are less active.

As mentioned earlier caloric restriction can also reduce obesity. But this is something the physical educator should not be involved with since medical supervision is needed when prescribing a diet.

Thus, the physical educator can make a major contribution towards controlling the obesity problem by initiating a screening program for obesity when the child first enters school.

Also the physical educator should encourage the obese child to participate in low-intensity, continuous activity. The rationale for this is based on adult data which has shown fat to be the primary source of energy for this type of activity. Furthermore, Dr. Nathan Smith speaking at the Maternal and Infant Nutrition Seminar in 1972 emphasized the importance of developing active lifestyles early in life that will effectively increase energy expenditures to minimize the accumulation of fat. Also the Committee on Pediatric Aspects of Physical Fitness, Recreation and Sports emphasized the attainment of physical fitness early in life by encouraging attitudes and behavior which can be carried over into adolescence and adulthood. Additionally, the committee stated that "...physical play instead of sedentary recreation may lead to activities later which have beneficial effects on preventing obesity, lowering the incidence of coronary heart disease and atherosclerosis and increasing cardiopulmonary efficiency as well as developing a joy of life".

In summary, the data shows that childhood obesity starts at a very early age and that preventive measures taken early enough may retard the development of the fat cells. Further, it appears that physical activity plays an important role in reducing obesity. The only problem with this is the activity program must start early - pre-school days. However, it is felt that by screening children for obesity when they first enter school along with a good physical activity program (i.e., 5 days per week, 1 hour per day), major steps can be taken towards reducing the obesity problem.