

Obesity and Weight Control

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Body composition is now a popular topic in Japan because most Japanese have become aware that obesity is a serious health problem increasing the risk of developing coronary artery disease, hypertension, diabetes and other health disorders. In Japan, analysis of body composition started in the 1960's mainly in the field of exercise and sports sciences. Densitometry, skinfold caliper method and ultrasound visualization has been the most widely used methods for the estimation of body composition.

Estimating body composition

The underwater weighing method has been the most common method of densitometry. But the spring scale that is typically used for the measurement of the underwater weight, does not allow a precise measurement. To improve the precision, a computerized apparatus was developed. The use of this computerized apparatus, however, was limited only in the specialized research laboratories. For a better public access, we developed a portable-type ultrasound apparatus to measure subcutaneous fat thickness. Based on the pre-calibrated estimation equation that is programmed in the apparatus, the body fatness is computed automatically upon the completion of measurement. Skinfold caliper is still a popular apparatus in Japan. It, however, does not

allow a reliable and valid estimation of the body fat for special populations, such as athletes and different age groups, although we have developed some new equations for children, adults of 20 to 59 years old and young athletes.

Physical fitness of obese person

An obese person typically scores low in a physical fitness test, for example, of vertical jump, 50 m run and endurance run. Does this poor physical fitness reflect poor physical functions of muscle and/or the respiratory-cardiovascular system? In order to describe the relations between physical fitness level and body fatness, jumping reaction time, muscle strength, anaerobic power output and maximum oxygen uptake were measured from obese males. All the subjects were young students aged 18 to 25 years old. As obesity was defined as "excessive enlargement of the body's total quantity of fat", over 20% of body fat for men and 30% for women were used as the criteria for obesity in the study. Jumping reaction time, EMG reaction time, movement time and whole body reaction time were measured from each subject. Isometric muscle strength was also measured on hand-grip, elbow flexion, trunk extension and knee extension. In addition, anaerobic power output was measured by the staircase climb test and VO_{2max}

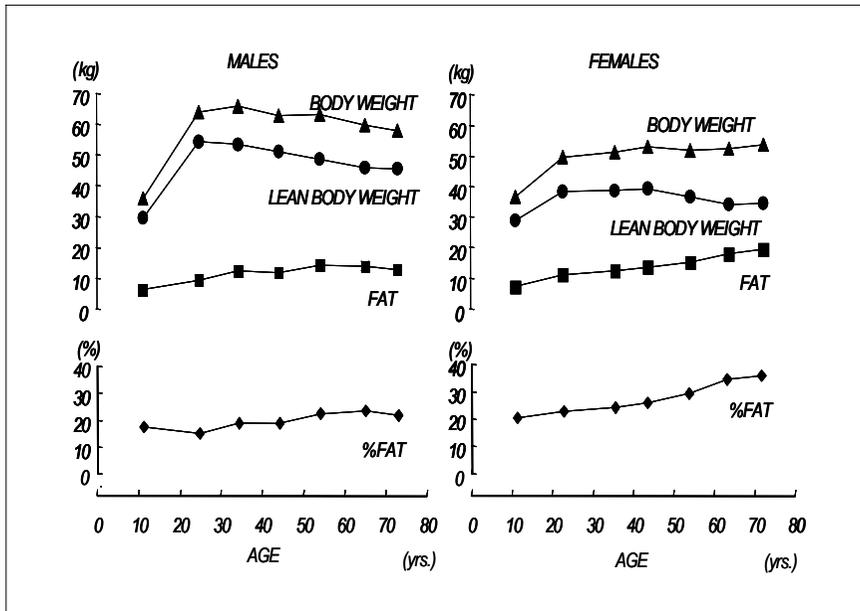


Fig. 1. Changes in Body Weight and Composition with Age

and the related variables were measured by treadmill running. From the limited scope of our findings about physical fitness of obese males, the results seems to suggest that obesity itself does not affect the intrinsic ability of neuro-muscular and respiratory-cardiovascular functions and that the excess fat of obese males only acted like an inactive load that decreased their physical fitness.

Changes with age in body composition of Japanese

There has been no reliable longitudinal-study conducted to examine the age-related changes of body composition among Japanese, whereas the previous study discussed the body composition changes among British and American populations. In order to determine a reasonable national standard in body composition among Japanese population, the sample of subjects selected for a study should not

differ in body height and weight by any more than 1 SD for the mean of the given age category cited in the Japanese Ministry of Education

Annual Report. Body composition was estimated by densitometry using the underwater-weighting method and pulmonary residual volume measurement. The percentage of body fat was computed from the body density based on the equation of Lohman et al. for prepubescent subjects, and the equation of Brozek et al. for adults. For the aged subjects of 60 to 76 years old, the density of lean body weight was also measured by the DEXA in order to examine whether or not densitometry could be applied to this population. Their densities resulted in 1.0950 ± 0.0036 g/mL for males and 1.0957 ± 0.0032 g/mL for females, which were quite similar to the 1.1 g/mL for adults proposed by Siri and Brozek et al. We, therefore, decided to apply the equation of Brozek et al. for the aged subjects.

The results of the study (Fig. 1) showed that body

weight, lean body weight and fat increased during adolescence, and in particular, a large increase was evident in body weight and lean body weight among males. The difference in body weight between males and females after the young adult stage seems to derive from a difference in lean body weight. The lean body weight of males decreased gradually from the young adult stage to the aged stage; the average decrement was calculated to be 3.7% per decade. Females did not show the clear change in lean body weight after the young adult stage. Fat continuously increased at a constant rate from the prepubescent to the aged stage in both sexes. The average increment was 6.2% per decade for males and 16.1% for females. The changing pattern of body composition in Japanese was very similar to that reported on British and American populations, but the decrement in lean body weight and increments in fat and percent body fat of this study were different from

British and American populations. Judging from Fig 1, it is about 50 years old for average Japanese males to become obese and about 60 years for females.

Energy expenditure of sports activity

Regular aerobic exercise brings about favorable changes in body weight and body composition. Walking, jogging and cycling are recommended for weight reduction.

Because they do not require a specialized training or equipment, they are relatively safe to perform and it is easy to estimate energy expenditure. Simple and repetitive nature of these exercises, however, often makes the performer feel too tiresome to continue the exercise. Recreational sports and games are more attractive than these exercises. For the recreational sports and games, however, it is difficult to deter-

Table 1. Energy Expenditure in Recreational and Sports Activity Measured Continuously by the Portable Type Apparatus

Activity	Sex	n	Energy expenditure		Measured time
			kcal/kg/min	kcal	min
Badminton (A)	F	6	0.126±0.029	54.0±5.8	8.5±1.9
Badminton (B)	M	10	0.162±0.025	298.3±35.8	16.8±4.5
Badminton	M	13	0.130±0.018	113.1±36.7	12.8±4.9
Basketball (A)	M	10	0.110±0.017	504.2±101.6	49.3±4.6
Bowling	M	13	0.055±0.009	132.8±26.1	35.0±3.1
Calisthenics	M	13	0.063±0.009	30.4±4.9	7.0±0.0
Golf	F	5	0.056±0.001	357.9±38.6	110.2±7.5
Golf	M	5	0.064±0.009	512.7±53.1	112.0±11.2
Soccer (A)	M	4	0.173±0.022	1153.7±212.6	90.9±0.0
Soft tennis (A)	M	14	0.130±0.029	87.7±47.7	10.2±4.2
Table tennis	M	13	0.089±0.019	68.2±13.7	11.2±1.1
Tennis (A)	M	10	0.112±0.029	163.8±55.8	23.0±4.8
Tennis	M	13	0.096±0.014	195.9±75.8	28.5±7.8
Volley ball (A)	F	9	0.126±0.020	205.3±52.9	25.6±4.9
Volley ball (A)	M	8	0.102±0.018	207.8±61.8	29.0±7.1
Weight training	M	13	0.091±0.005	108.5±10.3	18.0±0.0

A: athlete, M: male, F: female

(mean±SD)

mine energy expenditure precisely and the most values of energy expenditure listed in the textbooks are measured by conventional Douglas bag method that could not measure vigorous and continuous sports activity. So we measured the energy expenditure of some vigorous sports activities using a portable-type apparatus. As shown in Table 1, athletes showed higher values of energy expenditure than recreational players. This is probably due to the difference in their effectiveness of utilizing the body parts for maximizing the performance outcome. The results suggest that the energy expenditure during the vigorous sports activities is affected by the individual sports ability.

Effects of physical activity on weight reduction

Regular aerobic exercise brings about favorable changes: reducing body weight and fat while maintaining lean body weight. Amount of fat burned due to physical activity, however, is small. For example, one-hour walk burned at most 20 g of fat (fifty hours of walk is required to lose 1 kg of body fat!) Based on this datum, it is suggested that an exercise program should be continued for at least three to four months for reducing body weight and

fat. Our program for obese middle aged males: 90 minute bicycling consuming 300 kcal with intensity of 60% HRmax, three times a week and 14 weeks reduced averaged 1.4 kg of body fat of which internal fat was 0.2 kg.

People in the developed countries have lost their purpose to move in order to obtain food. Human being will not want to move and will keep energy in his body for starvation. So it will be still controversy whether or not physical activity plays a definite role to improve obesity even if everybody knows the positive effects of physical activity on body.

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