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Body composition and three indices of physical fitness in freshmen: exercise is of no effect ?

Kôji Taniguchi, Ichiji Seino, and Hidetoshi Konari.

Abstract

Grip strength, back strength, standing trunk flexion and skinfold thickness were measured on 314 freshmen (mean 18.6 years). Body composition was estimated by the method of measuring skinfold thickness. The subjects were asked whether they had belonged to athletic clubs in junior and/or senior high schools or not, and they were divided into four groups with regard to their answers.

Of the groups, group A is composed of 94 students who belonged to athletic clubs both in junior and senior high schools and group B is composed of 117 students who did not. The values of groups A and B were compared.

The results were as follows:

- 1) The mean value of fat storage rate (% fat) of all subjects was 21% and 44 per cent of them were judged to be obese.
- 2) The % fat of group A was smaller than that of group B.
- 3) Group A indicated significantly bigger Lean Body Mass (LBM) and LBM/Height-index than group B ($P < 0.01$).
- 4) The grip strength and back strength of group A were significantly better than those of group B ($P < 0.01$).
- 5) There was no statistical difference in standing trunk flexion between groups A and B.

From these results, it seems that exercise in adolescence keeps % fat small, promotes the development of muscle and enhances muscular strength.

The development of materialistic civilization have caused the shortage of physical activities. The shortage of physical activities is apt to induce obesity^{1),2)} and various diseases.^{3),4)} How should we judge obesity ? The method of judging obesity from the index of height and weight have been widely used: Rohrer index, Ponderal index, Kaup index, etc.^{5),6)} Suppose there are two persons of the same height and weight: one leads an active life, the other does

not. Can we conclude that there is no difference in body between the two persons ?

Generally speaking, endurance runners have smaller adipose tissue and weight lifters have bigger muscular tissue than inactive persons.^{7),8)} Judging obesity by the indices of anthropometry could be misleading. That is the reason why we apply the conception of "body composition". Body composition can be divided into Lean Body Mass and adipose tissue.^{9),10),11)} Body composition can not be directly measured *in vivo*, and so it is indirectly estimated various methods.^{10),12)~17)} Of the methods, the method of measuring skinfold thickness is widely applied because of its simplicity.^{6),18),19),20)}

There are many papers on the relation of physical activities to body composition.^{7),8),21)~24)} What about body composition in Japanese freshmen ? Masaki²⁵⁾ reported that the values of back strength and standing trunk flexion in Japanese pupils were decreasing. What about those in Japanese freshmen ?

The purpose of this paper is to estimate body composition in Japanese freshmen, and to examine the effect of exercise on body composition and three indices of physical fitness.

Methods

Subjects

Three hundred and fourteen freshmen in Muroran Institute of Technology participated in this study as subjects. They ranged in age from 18 to 21 years.

Body composition (% fat, LBM)

Skinfold thickness was measured with "Eikenshiki skinfold caliper".²⁶⁾ % fat was estimated by the modified method of Nagamine¹⁸⁾ and that of Brožek *et al.*²⁷⁾ LBM was calculated by using % fat derived from the methods described above: $LBM = (1 - \% \text{ fat}/100) \times \text{Weight}$. LBM represents muscular mass.¹¹⁾ LBM/Height-index represents the development of muscle.¹¹⁾ % weight was calculated

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on the basis of the standard weight in the hand book published from the Ministry of Welfare.²⁸⁾

Results

Physical characteristics and measurements of subjects are presented in table1. We compared our results with statistical data.^{29),30)} Our subjects were similar to those in the data in height, but significantly heavier in weight. Back strength and standing trunk flexion were inferior to those in the data, but grip strength was better. Skinfold thickness in tricep showed no significant difference, but that of subscapular showed significant difference.

Table 1 Physical characteristics and measurements of subjects. N=314

	Height (cm)	Weight (kg)	Rohrer index	% weight	S.T. tricep	S.T. subs.	S.T. sum
m	170.6	63.6	128.3	107.4	13.6	17.1	30.7
SD.	5.45	8.98**	18.12	14.35	7.22	9.45**	16.00**
	% fat	LBM	LBM/Height	Grip S.	Back-S.	Standing T.F.	
m	21.0	49.8	29.1	48.4	92.6	13.2	
SD.	7.87	5.02	2.46	7.16**	19.62**	5.99**	

S.T.: skinfold thickness. sum: tricep + subscapular.

* and ** show the significance at 5% and 1% level, respectively.

Nagamine⁶⁾ and Huenemann, R. L., *et al.*²⁾ recommend 20% fat as the criterion of obesity. In this study, 44 percent of all subjects were considered to be obese. LBM and LBM/Height-index showed smaller values than those of other reports.^{31)~34)}

Table 2 Comparison of the values between groups A and B.

		Height (cm)	Weight (kg)	Rohrer index	% weight	S.T. tricep	S.T. subs.	S.T. sum.
A: n=94	m	171.4	64.9	129.2	108.7	13.6	16.2	29.8
	S.D	5.22	7.96	17.03	13.14	7.08	8.61	14.99
B: n=117	m	169.5	62.3	127.9	106.4	14.5	18.4	32.9
	S.D	5.17**	9.17*	18.63	15.18	7.79	10.35	17.5
		% fat	LBM	LBM/Height	Grip S.	Back S	Standing T.F.	
A: n=94	m	20.4	51.3	29.9	49.2	95.9	13.7	
	S.D	7.37	4.80	2.30	6.87	18.36	6.51	
B: n=117	m	22.3	47.8	28.2	46.4	87.2	12.6	
	S.D	8.66	4.65***	2.35***	7.08***	20.35***	5.76	

Table 2 shows comparison of group A with group B. Height and weight showed significant difference ($P < 0.01$, $P < 0.05$). Skinfold thickness and % fat in group B showed large values. Muscular strengths were better in group A. LBM and LBM/Height-index were better in group A, too.

Table 3 shows the distribution of the degree of obesity from the viewpoints of % weight and % fat, Thirty per cent of subjects were judged to be obese with regard to % fat, but they could not be judged to be obese with regard to % weight. This tendency can be seen more in group B than in group A.

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Table 3 Distribution of the degree of obesity from the viewpoints of % weight and % fat

% fat		% weight	non-obesity				obesity
			~90	91~100	101~110	111~120	121~
non-obesity	~14		4	12	5	1	
			7	15	4		
			19	40	15	1	
	15~19			11	14	7	
			4	21	4	2	
			6	43	37	14	
obesity	20~24			2	11	5	1
				4	14	6	1
				7	36	18	5
	25~29				1	5	6
					7	6	1
					8	15	11
	30~					3	6
						7	14
						12	27

above column; numbers of group A.
middle column; numbers of group B.
under column; numbers of all subjects.

Consideration

The shortage of physical activities may replace a part of muscle with adipose.³⁵⁾ In this study, mean values of Rohrer index and % weight show no obesity, but those of % fat show obesity. Consequently we might say that many students wear excessive adipose coats.¹⁾ In other words, there may be many students lacking in sufficient muscular mass. This tendency is apt to be seen in group B.

Although Masaki²⁵⁾ reported that muscular strength was decreasing, we con-

sider this tendency as an excessive adiposity or lack of sufficient muscular mass. The moderns seem to have inactive life-styles. We expect that the majority of our subjects who have little experience of walking a long distance and exerting all their powers will have undeveloped muscles. This seems to be supported by the comparison between groups A and B: in group A, % fat was smaller, muscular strengths were better, LBM and LBM/Height-index were higher. We think that these are the effect of exercise in adolescence.

Although we have gained such conclusion as above, we concern about the results in group A. % fat of group A was higher than that of other reports. In addition LBM and LBM/Height-index were smaller than those in other reports.^{32), 38)} The values of group A were similar to those of inactive American young men.³⁹⁾ We must consider that the inactive life of students preparing for entrance examination had a great influence on our subjects.

Finally, we intend to increase the subjects of our investigation. We will get more information on body composition as well as on exact physical activities and make training programs for individuals.

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