A New Evaluation of Leanness/Obesity from the Viewpoint of Clothing Design

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Abstract In order to classify and evaluate leanness/obesity from the viewpoint of clothing design, somatometric measurements on 251 unmarried Japanese females aged 20 to 25 years are carried out and analyzed. The subjects are classified into 4 clusters by cluster analysis of 27 variables after a transformation of measurements to eliminate body size factor. This classification is considered to express how lean or how obese a human body appears and the combination of only three variables, which are waist girth, upper-arm girth, and calf girth, can correctly discriminate 89.24% of individuals.

In this study, the new concept of "apparent leanness/obesity" is defined in contrast to leanness/obesity determined by the subcutaneous fat thickness. Apparent leanness/obesity, judged not by body fat but by the contour of human body, has no close relation with subcutaneous fat thickness except the subjects who are judged to be obese by appearance. Means of measurements and indices exemplify the clear difference of body shape between the 4 clusters.

In conclusion, the concept of apparent leanness/obesity, different from leanness/obesity defined by body fat, has a very important value in practice as well as in the theory for designing clothing patterns.

Keywords Apparent leanness/obesity, Cluster analysis, Discriminant analysis, Clothing

Introduction

Degree of leanness or obesity has been defined by the percentage of body fat (% body fat), which is often estimated by measuring subcutaneous fat thickness, such as the sum of the thicknesses measured at the triceps and below scapula (NAGAMINE, 1972),

or by indices using stature and weight (ISHIKO, 1968). For medical and nutritional fields, leanness/obesity expressed by only a few human body composition may be effective.

From the viewpoint of making a clothing pattern or establishing a size system for ready-made clothing, on the other hand, the

terms "leanness" and "obesity" need to include the concept of human body shape. Due attention should be paid to body shape in addition to % body fat. Indeed, leanness/obesity has been revealed as an important component of human body in the results of many principal component analyses using somatometric measurements of adult females; the first principal component represents the variation in body size and the second represents the leanness/obesity (FUKUSHIMA, 1967; HIGUCHI *et al.*, 1976; INOUE and YANAGISAWA, 1978; and KOUCHI, 1979). However, leanness/obesity has never been defined nor seized quantitatively at all to design clothing.

Somatotype, proposed by SHELDON (1954) and developed by HEATH and CARTER (1967), is one of methods for classifying human body shape. The somatometry used in the method, however, does not have enough items of measurements to provide adequate information on body shape for the clothing design. One purpose of this study is, based on sufficient somatometric measurements, to analyze human body shape for the clothing design with an application of cluster and discriminant analyses. The other purpose is to propose a new concept of "apparent leanness/obesity" which is judged by the contour of human body, not by body composition as body fat, for the use of

Fig. 1. Somatometric measurements used in the cluster analysis.

clothing design process. Namely, this “apparent leanness/obesity” concept will be an useful tool for ranking how lean or how obese a human body appears.

Material and Method

Materials: Subjects are 251 unmarried Japanese females aged 20 to 25 years. Twenty-eight somatometric measurement items are chosen as shown in Fig. 1: stature, 4 depths, 7 breadths and widths, 12 girths, 3 subcutaneous fat thicknesses (SFTs), and weight. The measurement items are selected to include essential items for the clothing design and also the items representing leanness/obesity. These measurements are taken in accordance with the method used in the Investigation of the

Japanese Physique for Clothes Sizes (Japanese Standards Association, 1984), and three SFTs below scapula and at triceps and iliac crest at the just upper site of the iliac crest are measured with the Holtain Skinfold Caliper.

In order to examine intensively the relationship between apparent leanness/obesity and body fatness, 20 SFTs are taken at different body sites, as shown in Fig. 2, on another series of 56 unmarried Japanese females aged 20 to 30 years, using a B-scan ultrasonic tomograph (EUB-26, HITACHI-MEDICO).

Methods: (1) In order to classify each subjects based on the degree of leanness or obesity, cluster analysis for individuals is performed. Since one purpose of this clas-

Fig. 2. Measurements of subcutaneous fat thickness using a B-scan ultrasonic tomograph.

sification is to ascertain whether clothing should be designed in accordance with leanness/obesity or not, number of clusters are decided as four or five according to an ordinary classification of leanness/obesity, i. e., lean cluster, slightly lean cluster, normal cluster, slightly obese cluster, and obese cluster. Calculation is performed by the program package BMDP-2M, where similarities among individuals are examined by using Euclidean distance, and the group-average method is applied. The variables used in the analysis are derived from 27 somatometric measurements with a transformation for eliminating size factor. Namely, the standard score of stature is subtracted from each standard score of 27 measurements. The variables are defined as ZV variables, which are expressed as follows:

$$ZV_{ij} = (V_{ij} - \bar{V}_j) / S_j - (V_{ih} - \bar{V}_h) / S_h$$

$$(i=1, 2, \dots, 251; j=1, 2, \dots, 27)$$

where V_{ij} is the measurement of the j -item of the i -subject, and $\bar{V}_j$ and S_j are the mean and standard deviation of j -item. V_{ih} is the measurement of stature of the i -subject, and $\bar{V}_h$ and S_h are the mean and standard deviation of stature.

(2) In order to ascertain which variables contribute predominantly to the classification performed above, multiple discriminant analyses with variable selection are applied by the program package SPSS-DISCRIMINANT and several ZV variables are selected as a consequence.

(3) For each cluster of apparent leanness/obesity, which are decided by classifying 56 subjects using a few ZV variables selected above, the relationship between apparent leanness/obesity and SFTs is investigated after the calculation of each

mean value of 20 SFTs. Also relationship between the discriminant score of apparent leanness/obesity and SFTs is analyzed on their scatter diagram.

(4) For each cluster of apparent leanness/obesity, means and standard deviations of each 27 somatometric measurements, body length, height, and degree of shoulder slope are calculated (Tab. 2). In addition, the means and standard deviations of 26 indices are computed, as shown in Tab. 3. For testing statistical significance of mean difference among clusters, analysis of variance and Duncan's multiple range test are applied by program package SAS-GLM.

Results

(1) Classification of subjects based on apparent leanness/obesity.

From the results of the cluster analysis with the 27 ZV variables, the 251 subjects are classified into 4 clusters composed of 47, 122, 60, and 22 subjects, respectively. Every ZV variable shows the largest mean in the fourth cluster and decreases in downward order from the third cluster to the first cluster. Since ZV variable is designed to show the degree of excess or scantiness of the partial body size relative to the stature, a subject showing high ZV value indicates a relatively greater size of a body part. Thus, the fourth cluster of which all ZV means are the highest is judged to be a set of obese tendency subjects, while the first cluster of the lowest ZV means is judged to consist mostly of lean tendency subjects on the contour of the body. With consideration of this rank of clusters, the author designates the first cluster the "degree I" group, the second the "degree II", the third the "degree III", and the fourth the "degree IV" group.

It is considered that the rank of these four groups express how lean or how obese a human body appears, which is a very important concept in designing clothing. In this study, therefore, the author proposes a

new concept of “apparent leanness/obesity” which is determined by the contour of the body.

Discriminant analyses using each one of 27 ZV variables as an independent variable are performed for evaluating the correct discrimination into the four degrees. Results shown in Fig. 3 reveals that the high proportions of correct discrimination are obtained by the ZV variables of weight and three body segments: (seg. 1) bust girth, underbust girth, waist girth, and hip girth, (seg. 2) armscye girth, upper-arm girth, and forearm girth, (seg. 3) thigh girth and calf girth. That is to say, girths of the trunk, upper-limb, and lower limb respectively are the most prominent discriminators.

Tab. 1 shows a part of the results of multiple discriminant analysis which discriminates these four clusters with selection of ZV variables as independent variables. At the step 3, selected ZV variables as

Fig. 3. Correct discriminant proportion with one independent variable.

Tab. 1. Variables selected as independent variables in multiple discriminant analysis.

number of independent variable	independent variable	correct discriminant proportion
1	ZV waist girth	80.08%
2	ZV waist girth, ZV upper-arm girth	86.06%
3	ZV waist girth, ZV upper-arm girth, ZV calf girth	89.24%
4	ZV underbust girth, ZV calf girth, ZV subcutaneous fat thickness below scapula, ZV upper-arm girth	89.24%
6	ZV underbust girth, ZV calf girth, ZV subcutaneous fat thickness below scapula, ZV bust depth, ZV upper-arm girth, ZV neck girth	90.44%
27	all of 27 ZV variables used in the cluster analysis	93.63%

predominant contributors to the discrimination are waist girth, upper-arm girth, and calf girth which seem to represent girths of the trunk, the upper-limb, and the lower limb, respectively (c.f. Fig. 3). Although SFTs are usually employed to define obesity, the ZV variables of SFTs do not make much contribution to the discrimination. Moreover, another application of cluster analysis and discriminant analysis to 24 ZV variables excluding three of SFTs reveals nearly same result as the result shown in Tab. 1. Selected ZV variables in this discriminant analysis are waist, forearm, and thigh girth, which represent girths of the trunk, the upper-limb, and the lower limb, respectively.

The relationship between correct discriminant proportion and number of selected variables is also examined (Tab. 1). When only one variable, ZV waist girth, is chosen, the proportion is 80.08%, and it rises to 86.06% and 89.24% when two and three variables are chosen, respectively. However, no elevation of the proportion is found in the change from three to four variables. This 89.24% is adequately high proportion in comparison with 93.63% when all 27 variables are used. This means that three ZV variables correctly enough discriminate subjects into four clusters.

From these results, it is concluded that by using only three ZV variables of waist girth, upper-arm girth, and calf girth, which represent information at each body segment, discrimination can attain high correct discriminant proportion. The discriminant formula from these ZV variables is expressed as follows:

$$Y = 0.866X_1 + 0.654X_2 + 0.472X_3 - 0.001$$

where X_1 , X_2 , X_3 , are the ZV variables'

values of waist girth, upper-arm girth, and calf girth, respectively. By the magnitude of Y , the subject is classified as follows: degree I, if $Y \leq -1.90$; degree II, if $-1.90 < Y \leq 0.68$; degree III, if $0.68 < Y \leq 3.35$; and degree IV, if $3.35 < Y$.

(2) Relationship between apparent leanness/obesity and subcutaneous fat thickness.

i) In the preceding section, subjects are classified into four clusters, which are considered to show apparent leanness/obesity. Three measurements of SFT used in this cluster analysis make no great contribution to the discrimination of the four clusters. On the other hand, obesity is defined by percentage of body fat or SFTs in the field of medicine and nutrition. In order to investigate relationship between apparent leanness/obesity and SFTs, means of the 20 SFTs are calculated for each four clusters, as shown in Fig. 4. For this calculation, another series of samples consisting

Fig. 4. Each mean value of 20 subcutaneous fat thicknesses in each cluster of apparent leanness/obesity.

of 56 unmarried females is used and clustered by the above-mentioned formula ($Y = 0.866X_1 + 0.654X_2 + 0.472X_3 - 0.001$).

If the relationship is great, SFTs of degree IV should show the largest values among four degrees and those of degree III to I should decrease in this order. But in Fig. 4, SFTs of degree I, II and III do not show this pattern, though those of degree IV show the largest values in most of SFT sites. It is considered that the concept of apparent leanness/obesity has a no close relationship with SFTs excluding the case of subjects who are judged to be obviously obese from visual observation.

ii) Since the concept of "apparent leanness/obesity" is newly proposed in this study, the relation of this concept to the leanness or obesity of the other field of study should be examined. A scatter diagram between the discriminant score from the three ZV variables and the sum of two SFTs (below scapula and at triceps), which are measured by skinfold caliper, is shown in Fig. 5. In the case of adult female (NAGAMINE, 1972), the sum of SFTs between 45 and 55 mm corresponds to 30-35% body fat and is called

Fig. 5. Relationship between discriminant score of apparent leanness/obesity and judging obesity based on subcutaneous fat thickness.

mild obese. The sum of SFTs between 55 and 60 mm (35-40% body fat) is called moderate obese and SFTs over 60 mm (more than 40% body fat) is called marked obese.

Fig. 5 shows a close relation between discriminant scores and SFTs. This trend is understandable with due consideration that the increase of SFTs has influence on body shape. Careful examination, however, proves the dispersion which can not be neglected. For example, some subjects classified into the cluster of degree II by discriminant score are judged to be mild or moderate obese by the Nagamine-method, while some subjects of degree IV are judged not to be obese by the NAGAMINE-method. This discrepancy suggests that the two methods judge obesity differently from each other. This result reflects the difference of the concept of apparent leanness/obesity against that of SFTs.

In conclusion, the concept of apparent leanness/obesity and SFTs have no great interrelation nor direct connection with each other. The concept of apparent leanness/obesity does not accord with that of leanness/obesity defined by percentage of body fat or SFTs.

(3) Difference of body shape between clusters of apparent leanness/obesity.

In order to observe the difference of body shape between clusters of apparent leanness/obesity, the means and standard deviations of the 27 somatometric measurements used in the cluster analysis and other measurements such as body height, length, and degree of shoulder slope are calculated for each cluster, which are shown in Tab. 2. The analysis of variance and Duncan's multiple range test are also performed to test statistical significance of mean difference.

Tab. 2. Somatometric measurements in each cluster of apparent leanness/obesity.

i t e m s (unit = cm)	degree I (N=47)		degree II (N=122)		degree III (N=60)		degree IV (N=22)		analysis of variance	Duncan's multiple range test			
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.		I	II	III	IV
bust depth	20.22	1.63	20.59	1.24	21.65	1.38	23.69	1.57	**				
waist depth	15.90	1.23	16.20	1.15	16.78	1.38	18.56	1.80	**				
hip depth	21.55	1.32	22.10	1.37	23.18	1.81	24.30	1.61	**				
BNP $\rightarrow$ SNP $\rightarrow$ BP	32.92	1.56	33.15	1.77	33.51	1.78	34.71	2.19	**				
armscye width	9.82	0.79	10.21	0.73	10.90	0.96	11.30	0.90	**				
bust breadth	25.94	1.06	26.23	1.30	26.91	1.61	28.32	1.53	**				
waist breadth	21.86	1.27	22.40	1.38	22.95	1.65	24.47	1.50	**				
hip breadth	31.56	1.27	31.82	1.49	31.83	1.66	32.19	1.17	**				
posterior shoulder width	38.30	1.73	38.09	1.70	37.99	2.05	38.20	1.63					
posterior chest width	35.33	1.79	35.56	1.78	35.51	2.26	36.47	1.43					
anterior chest width	31.07	1.39	30.82	1.29	31.04	1.53	31.21	1.54					
bust girth	81.13	4.21	82.27	4.11	85.06	4.66	91.23	5.15	**				
underbust girth	70.53	3.25	70.63	3.38	72.21	3.83	77.18	4.24	**				
waist girth	62.42	3.45	63.31	3.66	65.30	4.24	70.83	4.79	**				
hip girth	89.42	3.79	90.32	3.82	91.75	4.34	94.58	3.71	**				
neck girth	31.68	1.20	31.68	1.34	32.29	1.47	32.55	1.26	**				
armscye girth	36.08	1.56	36.34	1.79	37.18	1.97	38.45	1.83	**				
upper-arm girth	24.92	1.61	25.92	1.67	27.50	2.07	28.92	1.72	**				
forearm girth	21.74	0.88	22.16	1.09	22.83	1.31	23.40	1.14	**				
wrist girth	14.72	0.62	14.75	0.73	15.09	0.82	15.33	0.77	**				
thigh girth	51.68	3.07	52.91	3.11	55.06	3.61	57.01	2.63	**				
calf girth	32.99	1.66	34.03	2.04	34.66	2.34	35.98	1.65	**				
ankle girth	20.54	1.12	20.69	1.12	21.00	1.38	21.28	1.11	*				
weight (kg)	50.97	4.75	51.24	5.49	53.09	6.58	56.68	5.78	**				
SFT below scapula (mm)	15.37	4.06	18.15	5.18	22.01	4.74	28.07	5.10	**				
SFT at triceps (mm)	15.28	4.24	17.23	4.25	19.28	4.14	23.80	3.44	**				
SFT at iliac crest (mm)	17.77	6.49	19.14	6.71	22.66	6.10	27.63	6.48	**				
stature	162.60	2.93	157.67	3.24	154.38	3.78	151.43	3.37	**				
acromion height	131.40	3.20	126.92	3.19	123.95	3.68	121.85	3.04	**				
posterior waist height	100.00	2.70	96.49	2.80	94.19	2.88	92.06	2.84	**				
posterior waist length	39.06	1.96	37.82	1.62	37.44	1.85	37.16	1.29	**				
upper-limb length	68.92	1.79	66.77	2.09	65.25	2.54	64.17	1.76	**				
lower-limb length	83.73	2.49	80.63	2.65	78.57	2.67	76.85	2.61	**				
shoulder slope (degree)	22.34	3.35	22.36	3.72	23.30	3.54	21.91	2.51					

** significant difference ($p < 0.01$)

* significant difference ($p < 0.05$)

Tab. 3. Indices in each cluster of apparent leanness/obesity.

i t e m s (X 100)	degree I (N=47)		degree II (N=122)		degree III (N=60)		degree IV (N=22)		analysis of variance	Duncan's multiple range test			
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.		I	II	III	IV
No.1 waist girth / bust girth	76.97	2.56	76.99	3.11	76.79	3.28	77.63	2.77					
No.2 hip girth / bust girth	110.37	4.71	109.91	4.23	107.99	4.45	103.84	4.22					
No.3 waist girth / hip girth	69.84	3.35	70.09	2.51	71.18	3.28	74.84	3.26	**				
No.4 neck girth / waist girth	50.84	2.29	50.12	2.19	49.56	2.42	46.07	2.19	**				
No.5 neck girth / bust girth	39.11	1.91	38.56	1.84	38.02	1.84	35.74	1.65	**				
No.6 bust depth / bust breadth	77.94	5.30	78.57	4.18	80.56	4.69	83.68	3.58	**				
No.7 waist depth / waist breadth	72.80	5.02	72.43	4.45	73.20	4.66	75.76	4.27	*				
No.8 hip depth / hip breadth	68.32	3.85	69.49	3.78	72.83	4.72	75.49	3.96	**				
No.9 SNP → BP / SNP → BP → WL	60.46	2.75	62.27	3.54	63.32	3.27	64.25	3.90	**				
No.10 SNP → BP / posterior waist length	65.13	4.25	67.55	4.47	68.95	4.33	72.10	5.42	**				
No.11 posterior chest width / posterior shoulder width	92.25	2.79	93.36	2.80	93.48	3.18	95.52	2.80	**				
No.12 anterior chest width / posterior shoulder width	81.23	4.21	81.00	3.65	81.80	3.67	81.71	2.51					
No.13 anterior chest width / posterior chest width	88.15	5.57	86.85	5.02	87.66	5.77	85.64	4.04					
No.14 posterior shoulder width / bust girth	47.29	2.53	46.37	2.32	44.73	2.41	41.95	1.86	**				
No.15 posterior chest width / bust girth	43.61	2.32	43.28	2.16	41.80	2.38	40.06	1.94	**				
No.16 anterior chest width / bust girth	38.37	2.14	37.52	1.81	36.54	1.79	34.27	1.64	**				
No.17 upper-arm girth / bust girth	30.73	1.51	31.52	1.56	32.33	1.68	31.73	1.42	**				
No.18 thigh girth / hip girth	57.80	2.66	58.55	1.72	59.97	1.80	60.28	1.49	**				
No.19 upper-arm girth / armscye girth	69.06	3.14	71.32	2.91	73.93	3.26	75.24	3.42	**				
No.20 armscye girth / bust girth	44.53	1.97	44.21	1.69	43.75	1.83	42.20	1.69	**				
No.21 armscye width / (shoulder height - armscye height)	96.06	9.86	102.20	9.84	105.90	10.70	108.85	8.98	**				
No.22 armscye width / armscye girth	27.22	1.77	28.09	1.34	29.30	1.64	29.39	1.65	**				
No.23 forearm girth / upper-arm girth	87.48	4.38	85.65	3.56	83.22	3.92	81.03	3.13	**				
No.24 wrist girth / upper-arm girth	59.24	3.48	57.02	3.01	55.05	3.20	53.13	3.04	**				
No.25 calf girth / thigh girth	63.92	2.78	64.38	2.87	63.01	3.07	63.16	2.46	*				
No.26 ankle girth / thigh girth	39.81	2.28	39.17	1.91	38.13	1.71	37.35	1.83	**				

** significant difference ($p < 0.01$)* significant difference ($p < 0.05$)

Of 34 somatometric measurements, 29 means are significantly different among four clusters. Means of all depths and breadths at the bust and waist, all 12 girths and 3 SFTs are the highest in degree IV and decrease in downward order of clusters. Results of DUNCAN's multiple range test show that most of means of degree IV and III are significantly higher than those of degree II and I. In the measurements of width at several points around the shoulder, on the other hand, no significant differences are observed among four cluster means. As general tendency, in upward order of clusters from degree I to IV, i.e., from a lean tendency to an obese tendency, the stature becomes lower, the extremities become shorter, the extremities and depths of the trunk become thicker, and weight becomes heavier.

Means of indices which indicate ratio between items of body girth, breadth, width, and depth are calculated for each cluster and listed in Tab. 3. From degree I to degree IV, the following tendency is observed. As for the body girth indices (No. 1-No. 5), the neck becomes slender in comparison with the girth of the trunk, while the bust girth and waist girth increase and the difference between waist girth and hip girth decreases. Body depth increases in comparison with breadth of the trunk (No. 6-No. 8), and indices of body length and breast volume (No. 9-No. 10) show the marked protuberance of the mamma. As for the body width measured at the several points and bust girth (No. 11-No. 16), posterior chest width becomes wide in comparison with posterior shoulder width, and the bust girth increases extremely in comparison with width around the shoulder. Indices of body girths on the trunk and extremities

(No. 17-No. 20) indicate that relative armscye girth to bust girth and upper-arm girth decreases. Shape of the armscye indices (No. 21-No. 22) show extreme increases of armscye width in comparison with depth at the armscye. As for the last four indices (No. 23-No. 26), girths at the distal and proximal parts of the extremities, the former's increase is less than that of latter, especially at the upper-limb.

In this section, it is ascertained that human body shape correlates with apparent leanness/obesity mainly at the trunk segment such as bust girth and waist girth. This agrees with the result of discriminant analysis that *ZV* variable of waist girth most contributes to the classification of 251 subjects.

Discussion and Conclusion

In the cluster analysis 251 subjects are classified into four clusters composed of 47, 122, 60, and 22 subjects respectively, which express the degree of apparent leanness/obesity. This result satisfies the requirement of classification into four or five clusters for a practical use in the clothing design. Moreover, 89.24% of subjects are correctly discriminated by only three *ZV* variables which represent the body trunk, upper-limb, and lower limb. Values of the classification as apparent leanness/obesity is ascertained by the clear difference of body shape between the four clusters.

For the clothing design, a new concept of "apparent leanness/obesity" is of great value in the next two points. First, though it is recognized that leanness/obesity has an important meaning as well as human body size in expressing the features of human body, there are few studies on leanness/obesity such as the definition of it from

the viewpoint of clothing design or the methods to make clothing patterns. These problems have been dealt with experiential techniques. In the situation like this, the present study indicates that apparent leanness/obesity has a definite meaning different from leanness/obesity in the other fields. It is considered that the present study indicates the necessity to investigate the leanness/obesity as the original problem to design clothing.

Secondly, according to the degree of apparent leanness/obesity from lean tendency to obese tendency, the following characteristics of body shape are demonstrated: (1) bust girth and waist girth increase extremely; (2) the difference between waist girth and hip girth decreases; (3) in the trunk segment, depth increases in comparison with breadth; (4) posterior chest width and armscye width increase relatively in comparison with measurements around shoulder; (5) neck girth decreases in comparison with girth in the trunk segment; (6) in the extremities, proximal parts increase relatively in comparison with distal parts. As preceding studies, in the viewpoint of clothing design SUZUKI *et al.* (1969, 1970) and TAKABU *et al.* (1972) observed the feature of obese children's body shape and set up the standards of clothing size by sexes, age groups, and kinds of clothing. ISOGAI and HARADA (1976) observed that the degree of leanness/obesity influences the items which are important to design clothing patterns. Though these rare studies focussed on leanness/obesity, the determination of obesity was based on the standard weight or index using only stature and weight. Therefore, it can be said that the present study performed a new evaluation of leanness/obesity.

Since clothing pattern is designed based on the development of the surface of human body, the degree of apparent leanness/obesity shown in the present study are very important not only in theory but also in practice. As a technique to cope with the degree of apparent leanness/obesity, it is inadequate merely to enlarge or reduce a clothing pattern while keeping it a similar figure. A countermeasure to cope with leanness/obesity should be discussed more in detail using also the knowledge of practical making of clothing.

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抄 録

衣服設計の立場からみた肥り痩せの新しい評価

植 竹 桃 子

衣服設計の立場から、肥り痩せの度合いによる個体の分類および評価を行った。被検者は、未婚の若い日本人成人女子 251 名である。身体の周径・矢状径・横径等の身体計測値から大きさのファクターを除去するように変換された 27 項目を用いてクラスター分析を行った結果、被検者は 4 クラスターに分類された。この分類は外形的な肥瘦の程度によるものとみなされ、またこれは変換された胴囲・上腕最大囲・下腿最大囲の

3項目のみを用いても89.24%の確率で可能であることが認められた。

このように本研究では、体脂肪率に基づいて定義されている肥瘦に対するものとして、「外形的に肥っている」或は「外形的に痩せている」という身体の外形から判断される「肥瘦」、すなわち「外形的肥瘦」の概念を打ち出した。そして、この外形的肥瘦と皮下脂肪厚とは、肥りと判定される個体以外では高い関連性をもつまでには至らないことが、また一般的に、外形的肥瘦の程度にしたがって身体の太さ・厚さ・幅に関するプロポーションが変化することが認められた。

したがって、外形的肥瘦の概念は、体脂肪率により定義されている肥瘦とは異なった意味をもつこと、さらに外形的肥瘦を充分に考慮した衣服の設計が必要であることが、提示された。

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