A FACTOR ANALYSIS OF GARMENT MEASURES OF DUTCH WOMEN *

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In 1951 a report was published about a project in which 5,001 Dutch women were measured to provide information for the garment industry (Sittig and Freudenthal, 1951). To provide an opportunity for comparison of these results with the results of a factor analysis by Heath (1952) of some of the measures on American women obtained by O'Brien and Shelton (1941), I factor analyzed the Dutch measures.

This paper consists of four parts. First the Dutch study will be described, next a factor analysis of the Dutch results will be described, in the third part the American study will be summarized and finally the two factor analyses will be compared.

Part I. The Dutch Study

The study was made by Sittig of the Dutch Advisory Bureau of Applied Statistics and Professor Freudenthal of the University of Utrecht, on a commission from the department store "De Bijenkorf" (the Beehive), in Amsterdam, which has branches in Den Haag and Rotterdam. Because the measures were taken in those stores (during August 18-30, 1947) the women were mostly from the urban, northwestern part of the Netherlands: only 6% were not living in two densely populated provinces, Noord Holland and Zuid Holland, and only 24% were not born in these two provinces. Recruitment of subjects was in these stores. Eighteen specially trained students performed the measurements which were selected and specified by Dr. A. DeFoe and Dr. J. Huizinga. The measurements made are shown in Table 1. This table also shows the means, standard deviations, with beta 1 and beta 2 as indices of kurtosis and skewness. Detailed descriptions of the measure-

* Permission to reproduce Figures 1 and 2 has been granted by the Dutch publisher Stafleu. The calculations were performed at the Computer Center of the University of Michigan with the help of Dr. James C. Lingoes. This study has been supported in part by grants K3-MH-18,382 and HD-00843 of the National Institutes of Health.

TABLE 1

The 15 measurements of 5,001 Dutch women with the means, standard deviations beta one and beta two obtained as indices of kurtosis and skewness

	Mean	S. D.	β_1	β_2
1. Weight	66.75 kg	10.91	.5	3.53
2. Stature	162.55 cm	6.48	.0008	3.05
3. Maximum chest girth	97.49 cm	10.05	.53	3.26
4. Minimum waist girth	79.95 cm	10.74	.48	2.99
5. Maximum hip girth	104.62 cm	9.13	.46	3.31
6. Front length, from cervical along neck across right breast to the waistline	50.68 cm	2.42	.46	4.08
7. Length of back, cervical to waist	39.09 cm	2.08	.016	3.90
8. Width of back between armpits	35.81 cm	2.59	.50	4.35
9. Sleeve length across outside of bent arm	58.53 cm	2.76	.00043	3.11
10. Hand circumference, across the four fingers on the knuckles	19.09 cm	.91	.019	3.20
11. Fist circumference (with thumb inside, across knuckles and nails)	24.41 cm	1.23	.0031	3.33
12. Length of middle finger	8.09 cm	.46	.01	3.14
13. Knee height (bottom of kneecap to floor)	43.08 cm	2.40	.016	3.13
14. Foot length	24.20 cm	1.10	.00007	3.45
15. Foot width	8.87 cm	.475	.13	3.18

ments, with photographs of a subject being measured may be found in the original Dutch monograph. The distribution of the women by age is shown in Table 2.

All the recorded figures were very carefully checked and the results for only 119 women had to be discarded because of one or more obviously wrong numbers.

The intercorrelations between the 15 measures are shown in Table 3.

An interesting diagram, presented in the original report is reproduced here as Figure 1, which shows graphically the strength of some of the intercorrelations.

It was found that there was a considerable relation between age and stature, i. e. younger age groups were taller, as well as between civil status and stature. Marriage and having children affected horizontal measures. Figure 2 shows the effect of age on stature, weight and waist circumference. It cannot be determined from this cross-sectional material

TABLE 2

Age distribution of the 5,001 *Dutch women*

Age	Number	%
18–22	619	12.4
23–27	567	11.3
28–32	477	9.5
33–37	470	9.4
38–42	574	11.5
43–47	609	12.2
48–52	584	11.7
53–57	464	9.3
58–62	319	6.4
63–67	196	3.9
68–72	82	1.6
73–77	32	0.6
78–82	8	0.2

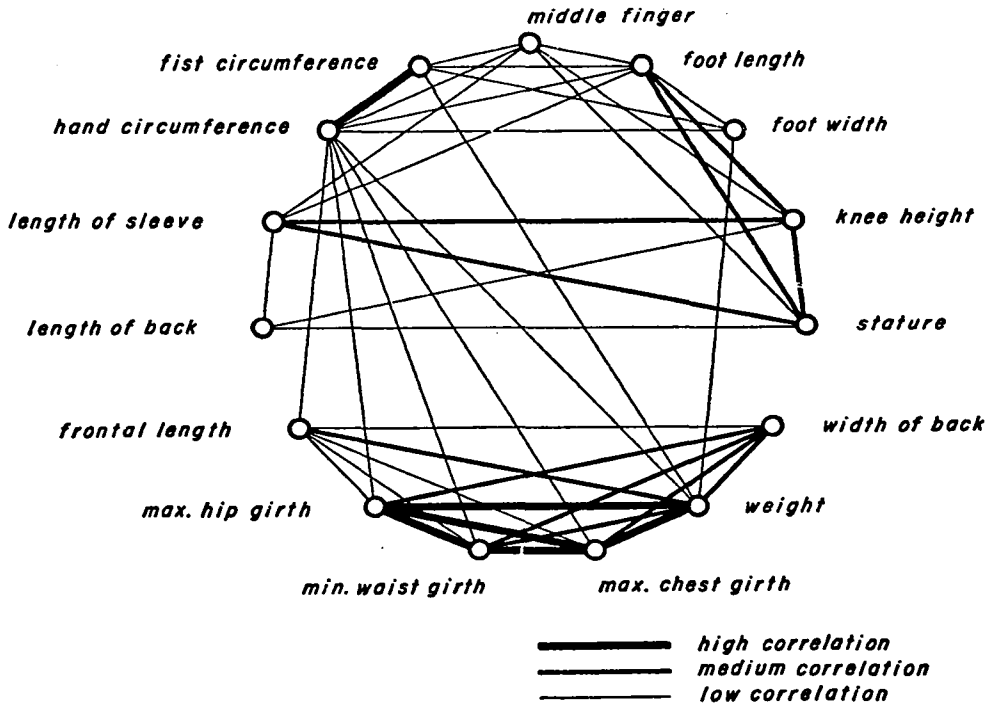
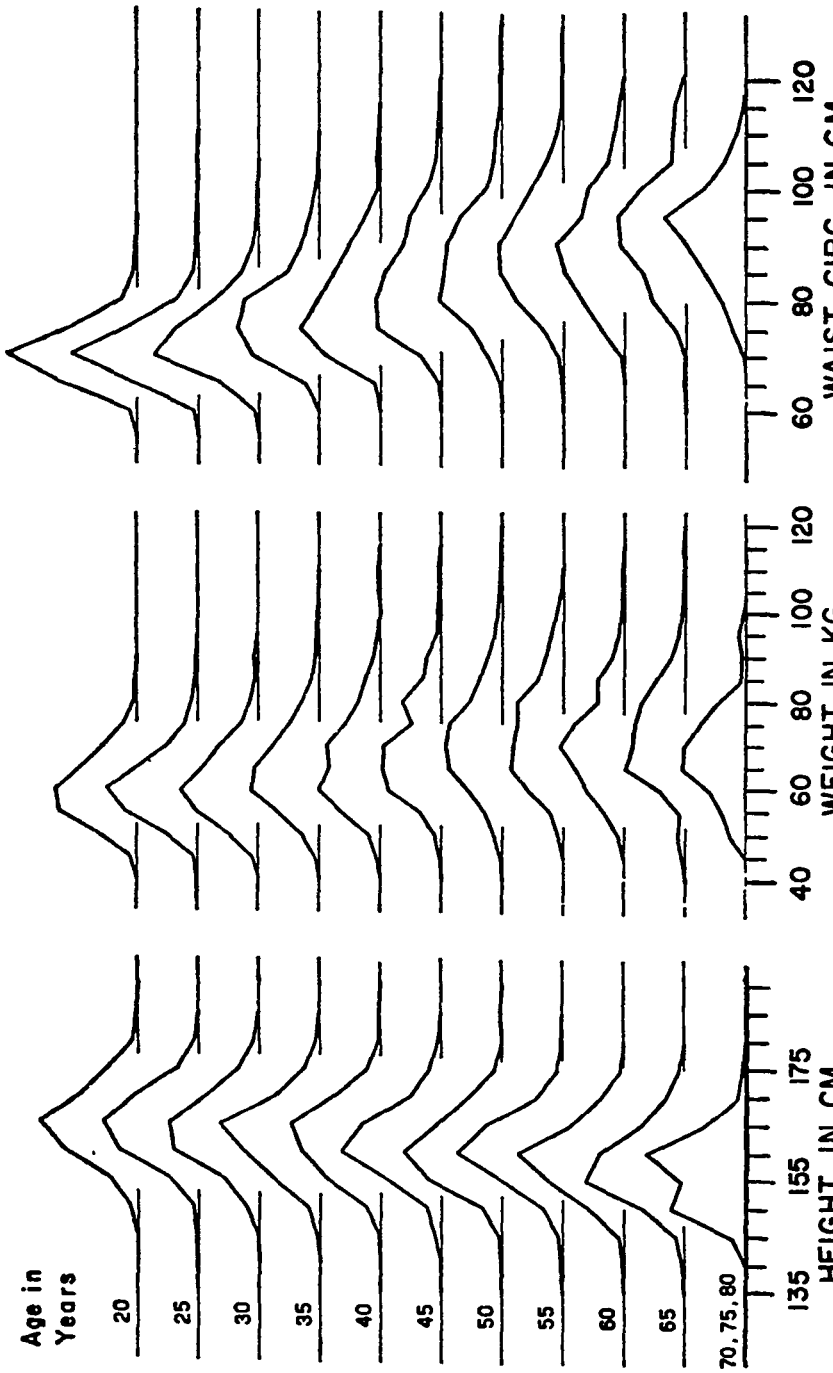


FIG. 1. A SCHEMATIC REPRESENTATION OF THE RELATIVE IMPORTANCE OF VARIOUS INTERCORRELATIONS AMONG 15 ANTHROPOMETIC VARIABLES FROM SITTIG AND FREUDENTHAL (1951)



FIG, 2. FREQUENCY DISTRIBUTIONS FOR STATURE, WEIGHT AND WAIST CIRCUMFERENCE PLOTTED SEPARATELY FOR 5 YEAR AGE GROUPS. AGE 25 INCLUDED INDIVIDUALS 23-27 YEARS OF AGE AND SO ON.

to what extent the observed differences are actually caused by aging and to what extent they reflect the general tendency for persons born more recently to grow taller, a tendency which appears to be rather universal all over the world.

Although age affected body dimensions, regression lines between measures calculated for different ages almost coincided, so the intercorrelations were computed by the authors for the total group of 5,001 women. The correlations between the body measures were found to be linear.

TABLE 3

Intercorrelations between 15 anthropometric measurements for 5,001 Dutch women

Variable	1†	2	3	4	5	6	7	8	9	10	11	12	13	14
2	212*													
3	870	−077												
4	837	−156	906											
5	913	−011	853	881										
6	601	258	567	453	458									
7	226	517	064	028	097	311								
8	676	058	692	647	629	436	196							
9	271	714	082	031	118	271	363	135						
10	495	229	401	408	411	338	171	341	311					
11	467	242	362	377	374	316	200	302	310	701				
12	267	506	116	098	144	229	278	172	484	458	440			
13	185	732	−012	−042	028	241	344	052	627	202	200	409		
14	360	645	154	139	227	299	339	193	567	419	391	581	573	
15	395	238	284	302	339	249	173	245	238	452	412	329	257	445

† For a list of the measurements see Table 1.
* Decimals omitted.

Part II. The Factor Analysis

The factor analysis was performed by me on a digital computer. A centroid analysis was made using the largest intercorrelation in each column as an estimate of the communality for that variable. Communalities were calculated after extraction of each factor. After 9 factors the communality of variable 1 reached .996, so extraction of factors was stopped. Actually, inspection of communalities, after a varying number of factors, showed no significant increases after 6 factors. In addition, since there were only 15 variables, it was decided to rotate

only the first 6 factors. These centroid factors and the communalities after 5, 6, 7, 8 and 9 are shown in Table 4.

TABLE 4.

Six centroid factors and communalities after 5, 6, 7, 8 *and* 9 *factors*

Variable	Centroid Factors I	II	III	IV	V	VI	Communalities after n factors n 5	6	7	8	9
1.	837*	445	204	089	060	–104	952	963	963	991	996
2.	550	–716	206	–105	103	–081	879	886	888	893	897
3.	673	665	212	066	–065	165	949	976	990	991	995
4.	632	678	101	196	018	105	908	919	930	941	942
5,	696	578	148	237	102	–081	907	914	934	943	948
6.	701	172	226	–140	–164	–050	619	621	646	669	677
7.	476	–340	190	–275	–165	–256	481	547	558	560	562
8.	659	440	185	–046	–171	118	693	707	727	730	741
9.	631	–562	134	–061	214	168	781	810	810	811	811
10.	751	105	–539	–151	128	021	905	905	918	921	922
11.	706	080	–510	–187	179	–045	832	834	836	842	843
12.	609	–371	–275	–046	–032	164	587	614	618	628	646
13.	558	–661	184	121	148	053	819	821	845	853	859
14.	687	–465	–126	220	–106	034	764	765	766	782	793
15.	628	–036	–308	238	–096	–129	556	573	580	580	597

* Decimals omitted.

Quartimax (Neuhaus and Wrigley 1954), Varimax (Kaiser 1958, 1959) and Oblimax (Saunders 1961) rotations were obtained which are shown in Table 5. The loadings are rounded to only two decimal places to save typesetting.

The first thing one notices about these three different rotations is that the quartimax produced 4 factors with at least one loading above .40, the varimax has 5 such factors and the oblimax rotation has only 3 factors with such loadings. The factors will be discussed simultaneously for all three rotational solutions. We will define as "significant" and discuss only loadings above .40 with some exceptions as follows: Figures in parentheses are less than .40 in one or two solutions. When the loadings in all three solutions, or in two of them, are less than .40 but more than .30, the entire line is put in brackets. The variable is included in the table in those cases, where it contains the highest value for that factor, because it may help the interpretation of the factor. Occasionally a loading below .40 in a solution may be mentioned.

Vandenberg, Steven, *A Factor Analysis of Garment Measures of Dutch Women* , Human Biology, 40:3 (1968:Sept.) p.295

TABLE 5

Rotation to an approximation of "simple structure" according to 3 mathematical criteria

	Quartimax						Varimax						Oblimax					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI
1. Weight	94*	22	08	07	01	–13	91	19	24	13	08	–15	67	12	04	02	–16	02
2. Stature	–04	92	01	15	–07	–08	–06	88	10	29	01	–07	–17	86	–14	18	–09	00
3. Max. chest girth	98	–04	01	–03	–05	14	97	–04	14	–01	–01	11	81	–14	–04	–02	13	–08
4. Min. waist girth	94	–09	07	–13	04	01	92	–09	20	–12	08	–01	78	–17	–01	–14	–01	–10
5. Max. hip girth	93	03	05	–07	08	–18	90	02	19	–04	14	–20	73	–06	00	–12	–22	–04
6. Front length	65	32	03	28	–03	10	63	26	16	35	02	09	44	26	01	17	11	16
7. Length of back	13	55	02	47	–02	–01	10	46	10	56	03	00	–06	53	05	30	01	31
8. Width of back	80	10	03	11	–03	20	79	07	16	15	01	18	63	03	–02	05	20	04
9. Sleeve length	12	87	10	–09	–16	03	09	86	22	05	–08	03	–04	79	–13	11	02	–25
10. Hand circumference	46	29	78	00	01	02	34	19	86	04	07	03	00	34	54	–01	02	–08
11. Fist circumference	41	29	76	04	–03	–05	29	19	84	08	03	–05	–06	33	57	05	–05	–07
12. Middle finger length	14	61	42	–04	09	20	06	54	50	05	15	21	–07	63	07	–08	17	–09
13. Knee height	03	90	–03	–10	03	–06	02	89	07	05	11	–05	–02	82	–30	–03	–10	–15
14. Foot length	19	75	23	–06	32	09	13	68	32	07	40	11	09	75	–20	–26	01	02
15. Foot width	38	35	39	–01	39	–05	30	26	46	45	05	–03	18	38	06	–30	–12	13

* Decimals omitted.

Factor I. The variables and their three sets of factor loadings are shown in Table 6. The factor is clearly defined by weight and measures of girth: chest, waist and hip. This is a factor described in a number of other studies and labeled variously as a volume or circumference or

TABLE 6

Loadings for some variables on factor I for three different rotations

Measure	*Var.*	*Quart.*	*Obl.*
1. Weight	91 *	94	67
3. Max. chest girth	97	98	81
4. Min. waist girth	92	94	78
5. Max. hip girth	90	93	73
6. Front Length	63	65	44
8. Width of back	79	80	63
10. Hand circumference	(34)	46	(00)
11. Fist circumference	(29)	41	(−06)
15. Foot width	(30)	(38)	(18)

* Decimals omitted.

weightiness factor ("ponderosity"). It contrasts the more rotund persons with the more slender. We will call it simply a weight factor. Persons who score high on this factor resemble Kretschmer's pyknic type or Sheldon's endomorphs.

TABLE 7

Loading for the variables of factor II *for three different rotations*

Measure	*Var.*	*Quart.*	*Obl.*
2. Stature	88 *	92	86
7. Length of back	46	55	53
9. Sleeve length	86	87	79
10. Hand circumference	(19)	(29)	(34)
11. Fist circumference	(19)	(29)	(33)
12. Middle finger length	54	61	63
13. Knee height	89	90	82
14. Foot length	68	75	75
15. Foot width	(26)	(35)	(38)

* Decimals omitted.

Factor II. The measures defining factor II, with significant loadings, are shown in Table 7. This factor is one of linearity or length. Persons high on this factor resemble Kretschmer's leptosome type or Sheldon's ectomorphs.

Factor III. The measures which define factor III are shown in Table 8. Because they are all at the end of the extremities we might call this a hand and foot factor. (It may be noted that the loadings for this factor are highest in the varimax rotation, next highest in the

TABLE 8

Loadings for the variables on factor III *for three rotations*

Measure	*Var.*	*Quart.*	*Obl.*
10. Hand circumference	86 *	78	54
11. Fist circumference	84	76	57
12. Middle finger length	50	42	(07)
{ 15. Foot width	46	(39)	(06) }

* Decimals omitted.

TABLE 9

Loadings for the variables on factor IV *for three rotations.*

Measure	*Var.*	*Quart.*	*Obl.*
{ 6. Front length	(35) *	(28)	(17) }
7. Length of back	56	47	(30)
{ 14. Foot length	(07)	(–06)	(–26) }
{ 15. Foot width	(05)	(–01)	(–30) }

* Decimals omitted.

quartimax rotation and lowest in the oblimax rotation. It reaffirms earlier findings that the quartimax method produces more of a general factor, and therefore lower loadings on the other factors, than does the varimax method, while the oblimax method tends to lead to lower loadings on some factors which appear as more important in orthogonal rotations because the oblique rotation allows correlation between factors). factors.)

Factor IV. The few measures which characterize this factor are shown in Table 9. They seem to deal with the trunk or center part of the body, but no clear interpretation is possible in a study with only 15 variables. In the oblimax and quartimax rotations the two trunk variables are contrasted with two variables for the foot.

Factor V. Only two variables have significant loadings in the varimax ratation of this factor. In the quartimax solution the loadings are not significant, but still suggestive. In the oblimax rotation the loadings are almost zero. Their variance has probably been absorbed in the negative loadings on factor IV. Table 10 shows these loadings.

TABLE 10

Loadings for the variables on factor V.

Measure	*Var.*	*Quart.*	*Obl.*
14. Foot length	40 *	(32)	(01)
15. Foot width	45	(39)	(–12)

* Decimals omitted.

Factor VI is a residual factor with no loadings which account for even as little as 10% of the variance, so that it will not be interpreted.

Part III. The American Study

In 1952 Helen Heath published a condensation of her University of Chicago doctoral thesis in which she reported on a factor analysis of women's measurements for garment and pattern construction. The intercorrelations between 29 variables were taken from a report by O'Brien and Shelton (1942) on a large WPA project in which 59 measurements were taken on 4,128 women to provide information to the garment industry about women's sizes. In the appendix to this report, correlations between all 59 variables are shown.

The measurements selected by Heath are shown in Table 11. For descriptions and photographs see the report by O'Brien and Shelton.

Five centroid factors were extracted by Heath. After iterating the computations four times with improved communality estimates, an oblique rotation solution was obtained for these five factors. The loadings obtained by Heath for the 29 variables on the five factors are shown in Table 12.

TABLE 11

The 29 measurements on 4,128 American women, their means and standard deviations

(all measures in inches, unless indicated otherwise)

Measure	*Mean*	*S. D.*
1. Weight in Kg.	60.55	11.78
2. Stature	63.16	2.48
3. Hip height	31.61	1.78
4. Tibiale height	17.22	1.07
5. Total post. arm length	23.00	1.17
6. Sitting height	24.60	1.19
7. Bust girth	35.62	3.87
8. Waist girth	29.15	4.45
9. Abdominal extension girth	36.20	4.71
10. Hip girth	38.82	3.34
11. Sitting spread girth	38.62	3.91
12. Maximum thigh girth	22.24	2.25
13. Midway thigh girth	19.57	2.03
14. Bent knee girth	14.29	1.38
15. Knee girth at tibiale	13.96	1.27
16. Maximum calf girth	13.45	1.20
17. Minimum leg girth	8.30	.69
18. Ankle girth	9.31	.67
19. Neck base girth	15.27	.93
20. Arm scye girth	16.10	1.55
21. Upper arm girth	11.37	1.51
22. Elbow girth	10.35	.88
23. Forearm girth	9.75	.84
24. Wrist girth	6.01	.38
25. Anterior chest width	12.47	.90
26. Highest bust level width	7.36	.81
27. Posterior chest width	13.39	1.22
28. Posterior hip arc	19.17	1.93
29. Angle of shoulder slope (in degrees)	23.08	4.13

TABLE 12

Oblique rotation factor matrix for 29 anthropometric measures (Heath 1952)

Variable	FACTOR I	II	III	IV	V
1	11 *	10	33	04	28
2	81	25	–01	02	01
3	92	–10	–01	00	00
4	77	–01	04	04	–07
5	76	09	–02	01	08
6	40	43	07	00	–02
7	–08	09	11	–01	53
8	–04	–06	17	00	47
9	–03	03	35	–08	31
10	–01	08	54	–02	04
11	–01	01	53	–01	04
12	–03	00	55	01	00
13	–06	–05	51	10	–01
14	07	01	31	38	–04
15	09	–11	33	40	–05
16	00	–02	33	38	–03
17	–10	25	08	59	–04
18	07	34	–04	50	07
19	10	07	–01	05	45
20	03	18	10	03	43
21	–10	–01	22	01	41
22	02	19	03	19	37
23	–03	19	09	19	38
24	12	22	–06	36	26
25	15	10	03	04	33
26	03	12	–03	03	36
27	04	10	06	00	36
28	–02	07	51	–05	00
29	00	07	–02	02	–05

* Decimals omitted.

The correlations between these 5 factors were reported too, as shown in Table 13.

TABLE 13

Correlations between the primary factors

	I	II	III	IV	V
I	1.00				
II	.22	1.00			
III	.12	.22	1.00		
IV	.18	.11	.60	1.00	
V	.09	.05	.75	.48	1.00

A second order solution for this, also slightly oblique, is shown in Table 14.

TABLE 14

Second order factors among the primary factors

	X	Y
Factor I	–009 *	459
Factor II	012	386
Factor III	849	072
Factor IV	574	110
Factor V	757	–103

* Decimals omitted.

The five factors, the variables which had significant loadings on them, and their interpretation by Heath were as follows:

Factor I Bone length

Variable	*Loading*
2. Stature	81 *
3. Hip height	92
4. Tibial height	77
5. Total posterior arm length	76
6. Sitting height	40

* Decimals omitted.

Factor II Cancellous bone size

Variable	*Loading*
6. Sitting height	43 *
18. Ankle girth	34

Factor III Fatty tissue on lower trunk and legs.

Variable	*Loading*
1. Weight	33 *
9. Abdominal extension girth	35
10. Hip girth	54
11. Sitting spread girth	53
12. Max. thigh girth	51
14. Bent knee girth	31
15. Knee girth at tibiale	33
16. Max. calf girth	33
28. Posterior hip arc	51

Factor IV Girth of extremities

Variable	*Loading*
14. Bent knee girth	38 *
15. Knee girth at tibiale	46
16. Max. calf girth	38
17. Min. leg girth	59
18. Ankle girth	50
24. Wrist girth	36

Factor V Girth measures of upper trunk and upper extremities.

Variable	*Loading*
7. Bust girth	53 *
8. Waist girth	47

* Decimals omitted.

9.	Abdominal extension girth	31
19.	Neck base girth	45
20.	Arm size girth	43
21.	Upper arm girth	41
22.	Elbow girth	37
23.	Forearm girth	38
25.	Anterior chest width	33
26.	Highest bust level width	36
27.	Posterior chest width	36

As mentioned above, these are the interpretations of the factors by Heath. They are, of course, dependent on the choice of variables included in the study. At a later time we hope to perform a factor analysis of the correlations for all 59 measures reported by O'Brien and Shelton.

Part IV. Comparison of the Dutch and American study.

Table 15 shows, at the top, the 5 variables which were included in both studies, while the lower part of this table lists 4 more variables which may be compared even though they are not identical. Using these 9 variables the degree of agreement between the two sets of factors was measured quantitatively by Tucker's index Ø computed for all possible combinations of factors. The formula for Ø is

$$\emptyset_{xy} = \frac{\sum^{i} x_i y_i}{\sqrt{\sum x_i^2 y_i^2}} \qquad (1)$$

Details of this index of factor similarity may be found in Tucker (1951). Table 16 shows the results obtained. Perfect agreement would be indicated by values close to 1.00 in the diagonal and close to .00 in the off diagonal cells. It must be kept in mind in studying this table that both sets of factors were somewhat oblique so that more than one factor was related to a factor in the other study, as can be seen. Nevertheless each factor resembles one in the comparison study more than it does all the others.

The Length Factor. Heath factor I " bone length " had a remarkable similarity to the length factor, factor II in the Dutch study, Ø being

TABLE 15

Sittig (Oblimax)					Variable	Variable		Heath (Oblique)				
II	I	III	IV	V	No. Name	Name	No.	I	V	IV	II	III
86*	−17	−14	18	−09	2 Stature	Stature		81	01	02	25	−01
−14	81	−04	−02	13	3 Chest width	Transverse chest	25	15	33	04	10	03
−17	78	−01	−14	−01	4 Waist girth	Waist girth	8	−04	47	00	−06	17
−06	73	00	−12	−22	5 Hip girth	Pelvic girth	10	−01	04	−02	08	54
12	67	04	02	−16	1 Weight	Weight	1	11	28	04	10	33
82	−02	−30	−03	−10	13 Knee height	Tibiale height	4	77	−07	04	−01	04
53	−06	05	30	01	7 Neck to waist	Sitting height	6	40	−02	00	43	07
26	44	01	17	11	8 Back width	Post. chest width	27	04	36	00	10	06
34	00	54	−01	02	10 Hand girth	Wrist girth	24	12	26	36	22	−06

* Decimals omitted.

.9443. This factor is also the one on which there is the clearest agreement between other investigators, although it has been given different names. It is often called a factor of general size, or when the contrast to measures of skinfold or fat is emphasized, a factor of general skeletal size. Persons high on this factor would be called leptosomes (Kretschmer) or ectomorphs (Sheldon).

The Weight Factor. Factor I in the Dutch material, which we called a weight factor, resembles factor V in the Heath study, which she called "girth of upper trunk and upper extremities." The index of agreement Ø equals .8208. However, Heath's factor III, which she called "fatty tissue on lower trunk and legs," also has a Ø of .7589 with this Dutch factor I. Unfortunately the Dutch measures did not allow a separation into two factors of the fatness of upper and of lower trunk. A general weight factor seems preferable. This off-diagonal value of .7589 is the highest by far in the table and reflects the fact that Heath's factors V and III had a correlation of .75.

TABLE 16

Indices of agreement between the factors from the studies by Heath and the present one based on the Dutch material

Heath's Factors		Sittig—Freudenthal—Vandenberg II	I	III	IV	V
Bone length	I	9443 *	–0015	–3376	4863	3192
Grith of upper trunk and upper extremities	V	0254	8208	3122	–0446	–1294
Girth of extremities	IV	3708	0699	7659	0075	–0358
Cancellous bone size	II	6671	1487	2973	7498	1078
Fatty tissue on lower trunk and legs	III	0328	7589	–0673	–1894	7160
		Length	Weight	Hand & Foot size	Trunk size?	Foot size?

* Decimals omitted.

A Factor for Hand and Foot. Factor IV in Health's study, her "girth of extremities" factor has an index Ø of agreement of .7659 with factor III in the Dutch data. We called this a "hand and foot" factor. It can be seen that there are only low Ø indices in the row and

column for these factors demonstrating the fact that this is a factor not related to any marked degree to the other four factors in either study.

The Trunk Factor. In the Dutch data we found a trunk factor, factor IV, characterized by the width and length of the back as contrasted to the length and width of the foot. This factor bears some resemblance apparently to Heath's factor II, which she called "cancellous bone size" because the Ø is .7498. However, the resemblance is poor. There are off diagonal Ø values of .6671 (between Heath's factor II and the Dutch length factor II, and between the Dutch factor IV and Heath's factor I, "bone length").

A Fifth Factor? Factor V in the Dutch data could not be interpreted clearly. It appeared only in the varimax and quartimax rotations and then only as a doublet of foot length and foot width. There is a Ø of .7160 between this factor and factor III in Heath's study, which she called "fatty tissue on lower trunk and leg." However, the Ø value between Heath's factor III and Dutch factor I, the weight factor is actually higher: a .7589, as mentioned above in the discussion of the weight factor.

In conclusion, we have seen that there is remarkable agreement between the length factors in both studies (Ø = .9443), but less clear agreement for the other four factors, as shown by lower Ø values and lack of clear correspondence between the variables defining the factors. The fact that the Dutch study employed only 15 variables while Heath's study was based on 29 variables undoubtedly contributed to this lack of clear correspondence.

In a second paper we plan to compare the results from two studies in which a larger set of common variables were measured; at that time the influence of selection of variables on the nature of factors in anthropometric studies will be discussed.

SUMMARY AND ABSTRACT

The intercorrelations of 15 measurements on 5,001 Dutch women were factor analyzed and rotated by 3 different computer programs (Quartimax, Varimax and Oblimax). Four factors were found. These were interpreted as a weight and circumference factor, a length factor, a factor dealing with the size of hands and feet, and a factor for the size of the trunk. A fifth factor for the size of the foot defined by two variables only was found in the varimax and quartimax rotations, but

this factor was absorbed into the fourth factor in the oblimax rotation (where trunk size and foot size were contrasted on a bipolar factor.)

The agreement with an earlier factor analysis by Heath of 29 measures on American women was investigated by computing indices of agreement Ø between all possible pairs of factors based on 9 variables which were the same or highly similar in both studies. Only for the length or general size factor was there good agreement, while less satisfactory agreement was found for a weight factor, a hand and foot factor and a trunk factor.

LITERATURE CITED

HEATH, HELEN 1952 A factor analysis of women's measurements taken for garment and pattern construction. Psychometrika, *17*: 87-100.

KAISER, H. F. 1958 The varimax criterion for analytic rotation in factor analysis. Psychometrika, *23*: 187-200.

——— 1959 Computer program for varimax rotation in factor analysis. Educ. Psychol. Measmt., *19*: 413-420.

NEUHAUS, J. O. AND C. F. WRIGLEY 1954 The quartimax method: An analytic approach to orthogonal simple structure. Brit. J. Statist. Psychol., 7: 81-91.

O'BRIEN, RUTH AND W. C. SHELTON 1941 Women's measurements for garment and pattern construction. Misc. publ. No. 454, U. S. Dept. of Agriculture, Wash., D. C.

SAUNDERS, D. R. 1961 The rationale for an "oblimax" method of transformation in factor analysis. Psychometrika, *20*: 317-324.

SITTIG, J. AND H. FREUDENTHAL 1951 De juiste maat (The correct measure) Stafleu, Leiden, Netherlands.

TUCKER, L. R. 1951 A method for synthesis of factor analytic studies. PRS Report No. 984, Dept. of the Army: Adjutant General's Office, Personnel Research Section, Washington, D. C.