AGE DIFFERENCES IN THE ANDROGYNY SCORE

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It has been suggested that the androgyny score, computed to estimate the degree of femininity of build in the male (Tanner, 1951), diminishes with increasing age (Kelsey, 1965; Henderson and Dugard, 1968). This paper describes age differences in the androgyny score in a cross-sectional study of men and women aged 20-90 years.

METHODS

The sample examined consisted of 413 men and 406 women aged 20-90 years. This sample was obtained in two parts. The first contained 215 men and 272 women aged 20-65 years, who formed a simple random sample of the 27,000 older people living in a defined area of Edinburgh. The method of sampling these subjects, who are taking part in a longitudinal study of ageing persons, has been described elsewhere (Milne, Maule, and Williamson, 1971). The second part was composed of 198 men and 134 women aged 20-65 years, who were donors providing blood at the Regional Blood Transfusion Service in Edinburgh. I attended donor sessions and circulated a leaflet requesting volunteers for anthropometry. More people volunteered than could be measured in the time available. Bias was introduced by the Blood Transfusion Service policy of rejecting donors under 5 feet (1.5 m) in height or 8 stone (50.8 kg) in weight. This sample, although not random, is from the population living in Edinburgh. The distribution of Landsteiner blood groups in the samples of older people and of blood donors, who were measured, did not differ significantly from that published for Edinburgh (Kopéc, 1970). In this respect, therefore, the samples do not differ from the population of Edinburgh. The age distribution of the combined samples of older people and blood donors is given in Table I.

Measurements of biacromial (BAD) and bi-iliac (BID) diameters were made from behind with the subjects standing, using the Harpenden anthropometer (Tanner and Whitehouse, 1957). Care was taken that the shoulders were in a relaxed position when measuring BAD, and that firm pressure was exerted with the branches of the anthropometer when measuring BID. The right suprailiac skinfold thickness was measured using the Harpenden caliper as described by Tanner (1959).

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TABLE I
AGE AND SEX DISTRIBUTION OF SAMPLE

Age Range	Men	Women
20-24	33	37
25-29	33	19
30-34	28	18
35-39	30	7
40-44	15	11
45-49	17	11
50-54	20	13
55-59	12	8
60-64	55	51
65-69	77	96
70-74	39	56
75-79	34	45
≥ 80	20	34
Total	413	406

The androgyny score was calculated as $3 \times \text{BAD}$ minus $1 \times \text{BID}$ (Tanner, 1951). Since the diameters were measured in millimetres, the androgyny score is 10 times the figure as originally described by Tanner.

RELIABILITY

This was studied by measuring the same 12 subjects on two occasions. A reliability coefficient was calculated, using the analysis of variance, by dividing the variance for persons by the sum of the variances due to persons, occasions, and error. Variance due to error was the residual mean square after removing variance due to persons and occasions. Coefficients for the author's variance determined in this way before and after the survey are given in Table II.

TABLE II
INTRA-OBSERVER AND INTER-OBSERVER
RELIABILITY STUDIES

	Reliability Coefficients			Number of Subjects
	Biacromial Diameter	Bi-iliac Diameter	Suprailiac Skinfold	
One observer				
Before survey	0.98	0.85	0.98	12
After survey	0.98	0.96	0.93	12
Two observers	0.86	0.88	—	12

An inter-observer study was carried out by the author and another observer measuring another 12 subjects on one occasion. Measurements were made so that one observer did not see the other at work. The coefficient was calculated with variance due to observers substituted for variance due to occasions. The results of this study (BAD and BID only) are also shown in Table II.

In the analysis of variance, the contributions to the total variance made by persons and occasions were examined using the F test. In all variables in the inter-observer and intra-observer studies the ratio of mean square for persons to mean square for error was significant at the 1% level. The corresponding ratio for occasions was significant only for bi-iliac diameter in 1970 and that just reached the 5% level. With this exception the principal contributor to the total variance was persons, and the observations can be accepted as reproducible.

RESULTS

Frequency distributions of androgyny score, BAD, and BID are given by decade for men and women separately in Figures 1, 2, and 3. For ease

FIG. 1. Frequency distribution of androgyny score (percentages) by decade in men and women.

of comparison the values used are percentages. The modal value of androgyny score and BAD in both sexes decreases in persons of 60 years and over, while the modal value of BID is greater in older people.

Mean values of the three variables with standard deviations and standard errors are given in five-year age groups in Table III. Inspection suggests little change in androgyny score or BAD in the age range from 20 to the fifties. Women thereafter show a gradual diminution in mean values up to old age but men have a sharp fall in mean values from the fifties to the mid-seventies and thereafter the fall levels off. The mean values of BID in both sexes increase gradually from 20 years of age to the fifties, after which the values seem relatively constant.

These age differences have been described using linear regressions. For each of the three variables, in women, two regression lines have been computed, one from 20 to 49 years and the other from 50 years to old age. In men, similar lines have been used for the regression of BID on age, but for androgyny score and BAD three lines were used covering age ranges 20-59, 55-74, and 70-≥80 years. The age ranges

FIG. 2. Frequency distribution (percentages) of biacromial diameter by decade in men and women.

FIG. 3. Frequency distribution (percentages) of bi-iliac diameter by decade in men and women.

FIG. 4. Frequency distribution (percentages) of right suprailiac skinfold thickness (log transformation) in men and women.

FIG. 5. Regression of androgyny score on age in men and women (± 1 standard error).

FIG. 6. Regression of biacromial diameter on age in men and women.

TABLE III

MEAN VALUES WITH STANDARD DEVIATIONS AND STANDARD ERRORS FOR ANDROGYNITY SCORE AND RELATED VARIABLES IN MEN AND WOMEN

Age Range	Androgyny Score			Biacromial Diameter (mm)			Bi-iliac Diameter (mm)			Suprailiac Skinfold (log)			N
	Mean	SD	SE	Mean	SD	SE	Mean	SD	SE	Mean	SD	SE	
Men													
20-24	908	52.3	9.1	397.9	20.5	3.6	285.5	23.4	4.1	203	25.7	4.5	33
25-29	927	41.1	7.2	404.7	16.2	2.8	286.5	23.9	4.2	209	23.2	4.0	33
30-34	928	47.4	9.0	406.5	18.3	3.5	291.3	16.2	3.1	216	21.8	4.1	28
35-39	916	54.1	9.9	403.2	20.6	3.8	293.2	17.0	3.1	220	18.4	3.4	30
40-44	892	40.6	10.5	396.9	18.1	4.7	298.5	31.2	8.1	214	21.3	5.5	15
45-49	916	35.4	8.6	404.9	12.7	3.1	299.1	17.5	4.2	224	16.7	4.0	17
50-54	906	49.4	11.1	400.2	17.4	3.9	294.5	17.2	3.9	212	14.2	3.2	20
55-59	922	83.4	24.1	408.5	27.7	8.0	303.4	16.5	4.8	224	12.8	3.7	12
60-64	857	48.5	6.6	386.2	18.9	2.6	301.5	16.1	2.2	193	30.0	4.1	54
65-69	843	53.1	6.1	380.9	19.6	2.2	299.6	14.3	1.6	195	30.2	3.4	77
70-74	815	54.9	8.9	371.5	19.6	3.2	299.1	13.4	2.2	183	30.5	4.9	38
75-79	815	45.2	7.8	374.1	18.6	3.2	307.3	19.5	3.3	196	29.5	5.1	34
≥ 80	811	43.5	9.7	371.1	15.3	3.4	302.8	21.9	4.9	188	32.8	7.5	20
Women													
20-24	818	40.4	6.6	365.4	14.6	2.4	278.4	12.9	2.1	207	19.1	3.1	37
25-29	815	44.4	10.2	367.0	16.1	3.7	285.5	16.6	3.8	206	23.8	5.5	19
30-34	817	39.1	9.2	366.3	15.9	3.8	282.5	12.1	2.8	204	22.4	5.3	18
35-39	812	38.0	14.4	362.9	14.0	5.3	276.7	10.8	4.1	200	25.7	9.7	7
40-44	813	38.6	11.6	369.4	16.3	4.9	294.6	14.6	4.4	210	22.5	6.8	11
45-49	816	29.7	9.0	369.6	9.9	3.0	292.8	20.1	6.1	209	16.9	5.1	11
50-54	801	41.9	11.6	367.1	15.2	4.2	300.5	12.3	3.4	212	17.4	4.8	13
55-59	778	39.0	13.8	355.5	13.3	4.7	289.0	14.9	5.3	213	21.6	7.6	8
60-64	756	36.0	5.1	351.4	13.5	1.9	298.6	17.6	2.5	202	26.3	3.7	51
65-69	743	42.6	4.4	347.1	16.9	1.8	298.2	19.7	2.0	201	32.4	3.3	94
70-74	735	40.8	5.5	346.3	14.8	2.0	303.7	18.7	2.5	203	26.0	3.5	55
75-79	726	49.7	7.5	342.0	19.3	2.9	300.1	19.2	2.9	195	27.4	4.1	44
≥ 80	716	48.2	8.5	338.7	18.8	3.3	300.5	17.6	3.1	194	31.1	5.5	32

Data missing in 2 men and 6 women

TABLE IV

REGRESSIONS OF ANDROGYNITY SCORE AND RELATED VARIABLES ON AGE IN MEN AND WOMEN

Sex and Age Range	Constant	Regression Coefficient (age)	S.E.E. Regression Coefficient	SE of Regression	Mean of Dependent Variable	Mean Age	N
ANDROGYNITY SCORE							
Men							
20-59	+925.3325	-0.2605	0.3360	50.4	916	36.0	188
55-74	+1236.6282	-5.9085**	0.9695	54.4	847	66.0	181
70 — ≥ 80	+844.2635	-0.3956	1.0326	48.9	814	76.1	92
Women							
20-49	+817.6824	-0.0556	0.4450	38.9	816	30.3	103
50 — ≥ 80	+898.0156	-2.2435**	0.3127	42.8	742	69.7	297
BIACROMIAL DIAMETER							
Men							
20-59	+400.1670	+0.0701	0.1262	18.9	402.7	36.0	188
55-74	+517.9582	-2.0550**	0.3543	19.9	382.4	66.0	181
70 — ≥ 80	+375.0335	-0.0351	0.3861	18.3	372.4	76.1	92
Women							
20-49	+361.7358	+0.1581	0.1673	14.6	366.5	30.3	103
50 — ≥ 80	+395.9972	-0.7014**	0.1199	16.4	347.1	69.7	297
BI-ILIAC DIAMETER							
Men							
20-49	+270.9997	+0.6153**	0.2070	21.3	291.0	32.4	156
50 — ≥ 80	+285.4072	+0.2303	0.1256	16.3	301.0	67.7	255
Women							
20-49	+267.5252	+0.5298**	0.1681	14.7	283.6	30.3	103
50 — ≥ 80	+289.9760	+0.1393	0.1350	18.5	299.7	69.7	297
SUPRAILIAC SKINFOLD (LOG)							
Men							
20-49	+195.0661	+0.5085*	0.2169	22.3	212	32.4	156
50 — ≥ 80	+243.7765	-0.7585**	0.2277	29.5	192	67.6	255
Women							
20-49	+201.2777	+0.1317	0.2419	21.1	205	30.3	103
50 — ≥ 80	+235.3916	-0.5016*	0.1987	27.2	200	69.7	298

* P < 0.05
** P < 0.01

FIG. 7. Regression of bi-iliac diameter on age in men and women.

used in the regression of these dependent variables on age were selected by examining the table of five-year means (Table III) to discover the age ranges with the greatest and least variation for each dependent variable.

The regressions of androgyny score, BAD, and BID on age are given in Table IV and in Figures 5, 6, and 7. For androgyny score and BAD in women, the regression coefficients for age are significant in the age range 50 to old age but not in the age range 20-49. In men these coefficients are significant in the range 55-74 years but not in age ranges 20-59 and 70 to old age. In men and women the regression coefficient for age in respect of BID is significant in the age range 20-49 but not in older people.

The fall in BAD and the rise in BID with increasing age both tend to lower the androgyny score. The rise in BID with age might be due to increasing obesity. This possibility was investigated by measuring the right suprailiac skinfold thickness. Five-year means of the log transformation of this variable (Edwards *et al.*, 1955) are reported in Table III and its regression on age in Table IV for age ranges 20-49 and 50 to old age (Figure 8). This analysis reveals an increase in the skinfold thickness with increasing age in men, but not in women, up to age 50. Thereafter in both sexes the fall with increasing age is significant. At ages when the androgyny score is falling in value and the BID appears constant, the suprailiac skinfold thickness is also decreasing (Figure 8).

DISCUSSION

This cross-sectional study confirms that there is an age difference in the androgyny score, the decrease in both sexes beginning in the fifties. A sex difference is also present in that the score in women continues to fall up to old age, while in men a steep fall in the

FIG. 8. Regression of right suprailiac skinfold thickness (log transformation) on age in men and women.

years 55-74 levels off in old age. Because the study is cross-sectional, the differences found are likely to have been greatly influenced by the effects of mortality. The mortality rates for 1969 in Scotland for men aged 55-64 and 65-74 are respectively 24.7 and 59.2 per 1,000, the corresponding figures in women being 12.9 and 32.9 (Registrar General for Scotland, 1971). It is possible that an association between this greater mortality, in men compared with women, and the androgyny score in these age groups explains the steep fall, found in men only, in the regression of androgyny on age from 55-74 years. Figure 5 shows that the men who survive this period tend towards 'femaleness' as measured by the androgyny score. Greater 'maleness' as measured by this score may militate against survival in middle age.

Some support is given to this hypothesis by the author's unpublished data concerning men, in the present study, aged 62-74 years. These men form part of the sample being studied longitudinally and have had a full clinical examination including electrocardiography. No comparable information is available about men younger than 62 who were blood donors not studied in such detail. The men aged 62-74 can be divided into those with probable and possible ischaemic heart disease, as defined by Reid, Holland, Humerfelt, and Rose (1966), and those with no evidence of such disease. The mean androgyny score in 20 men with probable ischaemic heart disease is 855 (SE 11.3) compared with 836 (SE 5.1) in 106 men with no evidence of such disease. The possible group has a mean value between these figures. Although the confidence limits of these means overlap, possibly because of small sample sizes, the figures suggest that during the age period where the regression line of androgyny on age falls steeply, men with a disease known to be an

important contributor to middle-aged mortality have a higher mean androgyny score than men with no evidence of this disease. Longitudinal study would be needed to examine properly this apparent association between maleness, measured by the androgyny score, and middle-aged mortality. Such a study would also show whether the age differences described in this paper overestimate age changes.

With increasing age, biacromial diameter and bi-iliac diameter both show differences in directions which lower the androgyny score. The bi-iliac diameter, after increasing up to age 50, remains constant thereafter. The fall in the androgyny score in older people is therefore due to a decrease in the biacromial diameter. The constancy of the bi-iliac diameter in persons above 50 years of age and the decrease in suprailiac skinfold thickness in this age group suggest that an increase in bi-iliac diameter due to obesity is not an important cause of the lower androgyny scores in older people. Kelsey (1965) showed in the relatives of schizophrenic patients that an increase with age in bi-iliac diameter was not associated with an increase in weight.

Androgyny score has been studied in relation to mental illness (Ray and Coppen, 1959; Kelsey, 1965; Henderson and Dugard, 1968; Price, 1969) and to sexual disorders (Coppen, 1959; Johnston, 1965). Men who were hypogonadal or who had female sex chromatin were found to have decreased biacromial diameters (Raboch, 1957) while women with hirsuties and increased urinary 17-ketosteroid excretion had an increase in this measurement (Ferriman, Thomas, and Purdie, 1957). The findings in respect of age differences in the present study emphasize the need, mentioned by Kelsey, to allow for age when relating any disorder to the androgyny score.

Measurement figures in the present study agree fairly well with control figures given by other authors (Ray and Coppen, 1959; Kelsey, 1965; Johnston, 1965). One large study (Board of Trade, 1957) in women, of anthropometry in relation to clothing sizes, included the biacromial but not the bi-iliac diameter. In women aged 20-54, the BAD was found to be very close to 350 mm. In corresponding five-year age groups this figure is 15-20 mm less than in the present study. The Board of Trade report gives a clear description of how the BAD was measured but does not mention any instruction to make the measurement with the shoulders of the subject relaxed. This difference in technique may explain the difference in results.

The fall in the androgyny score as age increases may result from changes in the shape of the thorax. The anteroposterior diameter of the thorax is known

to increase and the transverse diameter to diminish with increasing age. Increase in anteroposterior diameter is associated with increased kyphosis, in turn associated with changes in the shape of vertebral bodies resulting from senile osteoporosis. These vertebral changes begin after 50 years in women and after 60 years in men. The effect of the change in shape of the thorax is to bring the scapulae closer together with a decrease in biacromial diameter and androgyny score.

SUMMARY

The androgyny score was calculated from biacromial and bi-iliac diameters measured in Edinburgh in 413 men and 406 women aged 20-90. The score showed a fall in both sexes beginning in the fifties. The fall was gradual in women and steeper, with later levelling off, in men. The steep fall in men may be associated with increased mortality among those men with greater degrees of maleness as measured by the androgyny score. Reduction in biacromial diameter was the main factor in the fall of the score. Larger bi-iliac diameters in older people were not associated with increased subcutaneous fat.

I wish to thank Dr. J. Williamson (Director, Geriatric Research Unit), Dr. R. A. Cumming and Dr. A. E. Robertson of the Regional Blood Transfusion Service, Edinburgh, for allowing access to donors and providing accommodation for measurement, Dr. Keith Hope (Fellow of Nuffield College, Oxford) for help with reliability studies, Mr. Ian J. Lauder (MRC Clinical and Population Cytogenetics Unit, Edinburgh) for help with statistical analysis, and Staff Nurse S. Cormack (Royal Victoria Hospital, Edinburgh) for help in carrying out the measurements.

This work was supported by a grant from the Secretary of State for Scotland via the Advisory Committee on Medical Research.

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