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AN ANTHROPOMETRIC STUDY OF HEAD AND FACE OF MATURE ADULTS IN SWEDEN

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INTRODUCTION

Through *Lindegård's* (1953) biometric study of the head and face and the investigations of the facial profile by *Björk* (1947, 1955) and *Sarnäs* (1959) the growth, form and size of the head and face in young adults of Swedish males has been elucidated. On the other hand, there is no anthropometric data on the head and face of *mature* adults in Sweden. In connection with somatometric studies of mature adults (*Lewin*, 1969) the authors have therefore performed measurements of the most common head and face dimensions. This paper deals with these studies of head and face of mature adults of both sexes.

MATERIAL AND METHODS

Material. By using tables of random figures, the present subjects were selected from all employees (1605 males, 419 females) aged 25—49 years with Swedish citizenship at the Swedish Ball-Bearing Company in Gothenburg (SKF). One hundred males and one hundred females selected as primary subjects were asked to take part in the investigation, as were a further 30 females selected as reserves in the event of non-response. Of these, 87 males

Table I
Participation of primary and extra subjects in the investigation

	No. of primary subjects chosen		No. of extra subjects chosen		Total	
	Male	Female	Male	Female	Male	Female
No. of subjects investigated	87	60	0	17	87	77
No. of subjects not investigated	13	40	0	13	13	53
Total	100	100	0	30	100	130

Table II
Reasons for absence among the subjects chosen at random and requested to take part in the investigation

Reason for absence	No. among primary subjects		No. among extra subjects		Total	
	Male	Female	Male	Female	Male	Female
Left work	2	6	—	—	2	6
Not Swede by birth	2	2	—	—	2	2
Sick-leave	2	9	—	5	2	14
Refused investigation	7	23	—	8	7	31
	13	40	—	13	13	53

and 77 females took part in the investigation (Table I). The most common reasons why persons chosen did not take part were sickleave from work and unwillingness to participate in the investigation (Table II).

The males showed an even distribution by age over the entire range 25—49 years, whereas the females had an excessive representation in the interval 35—49 years (Fig. 1). There was no marked difference between the sexes in the geographical distribution of the subjects' places of birth (Table III). Most of the subjects were born in Gothenburg and adjacent counties (65 males and 55 females). None of the subjects were known to be of foreign descent.

Measurements. The measurements (Table IV) carried out according to the instructions of *Martin-Saller* (1957). Error of measurements were studied by measuring 25 individuals at two different occasions. These determinations showed a standard error of the measurements of 0.8—1.2 mm.

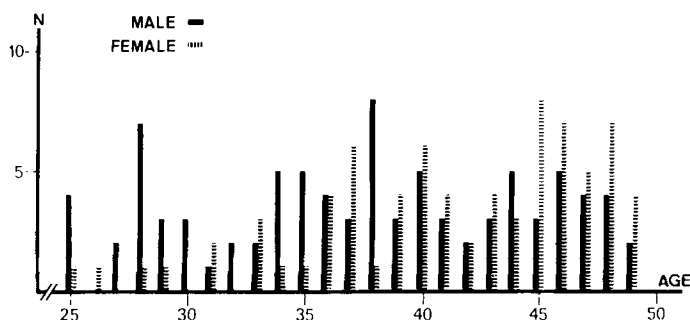


Fig. 1. Age distribution of the investigated material.

Statistics. The mean error of the means and the standard deviation (S.D.) were calculated according to current standard formulae. Differences between means were analysed with Students' t-test, the value of t being calculated

$$t = \frac{X_1 - X_2}{S.D. \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}, \text{ where}$$

$$S.D. = \frac{(n_1 - 1) S.D._1^2 + (n_2 - 1) S.D._2^2}{n_1 + n_2 - 2}$$

Table III
Geographic distribution of the subjects by place of birth

County	Male		Female	
Cöteborgs- and Bohus län*)	53		44	
Älvsborgs län	7		9	
Skaraborgs län	5	65**)	2	55**)
Hallands län	3	3	3	3
Kronobergs län	2		3	
Kalmar län	3	5	2	5
Blekinge län	1	1	2	2
Värmlands län	3	3	6	6
Södermanlands län	3		1	
Östergötlands län	1	4	1	2
Kopparbergs län	0		2	
Västmanlands län	1	1	0	2
Gävleborgs län	0		1	
Västernorrlands län	2		0	
Jämtlands län	1	3	0	1
Norrbottnens län	2	2	1	1
	87	87	77	77

*) län = county

**) adjacent counties of Gothenburg

Table IV
Measurements of head and face

	<u>n</u>	M	E _(M)	S. D.	Range	<u>n</u>	M	E _(M)	S. D.	Range	Difference
Head length (1)	87	195.0	0.6	6.2	181—212	77	186.1	0.6	5.6	175—195	1.6
Head breadth (3)	86	150.0	0.6	5.5	137—160	77	145.8	0.6	4.8	131—156	0.9
Frontal breadth (4)	87	106.8	0.6	5.3	95—118	77	102.9	0.7	5.8	90—118	0.7
Bizygomatic breadth (6)	87	133.4	0.7	6.4	117—153	77	125.2	0.9	7.8	115—151	1.1
Bigonial breadth (8)	87	111.5	0.7	6.2	96—128	77	106.0	0.6	5.7	95—117	1.0
Morphologic face height (18)	87	120.3	0.6	5.4	110—133	77	112.3	0.9	8.0	91—127	1.0

M, arithmetic mean; E_(M), standard error of the mean; S. D., standard deviation. Figures in parentheses refer to Martin-Saller. The difference between means is expressed in S. D. units of females.

Table V
Correlations between head and face measurements

	Head length	Head breadth	Frontal breadth	Bizygomatic breadth	Bigonial breadth	Morphologic face height
Head length	♂ —	♀ —	♂ 0.24*	♀ 0.28*	♂ 0.33*	♀ 0.28*
Head breadth	0.00	0.18	0.24*	0.41*	0.09	0.11
Frontal breadth	0.24*	—	—	—	0.26*	0.21*
Bizygomatic breadth	0.05	0.24*	0.19	0.36*	0.37*	0.22*
Bigonial breadth	0.33*	0.06	0.26*	—	—	0.31*
Morphologic face height	0.29*	0.15	0.21*	0.40*	0.31	—
		0.28*	0.17	0.22*	0.40*	—

*) Significant correlation.

Table VI
Head and face indices

	Males			Females		
	M	S.D.	Range	M	S.D.	Range
Length-breadth index (cephalic 8/1)	77.1	3.1	69—84	78.4	3.3	71—91
Fronto-parietal index (9/8)	71.4	4.1	65—85	70.7	3.7	63—82
Total facial index (47/45)	90.3	3.2	77—103	90.0	6.8	72—123

Figures in parantheses refer to *Martin-Saller*. (*loc.cit.*)

Throughout the tables significant differences between means are given in female S.D. units, i.e., the difference between male and female means in millimetres divided by the female S.D. of the actual measurement.

Relationships between different dimensions were studied product moment correlation, using the method of least squares.

The level of significance was set at 95 % throughout.

RESULTS

The means, standard deviation and ranges for the dimensions are shown in Table IV. For all dimensions significantly higher means were obtained for the males than for the females.

The association between head and face dimensions was examined by means of the product moment correlation; the results are presented in Table V.

No significant positive correlations between the length and breadth of the head were found. On the other hand, each of these dimensions showed a significant positive correlation with the smallest frontal breadth. Between all the face dimensions there were positive significant correlations.

Between the head and face dimensions there were significant correlations for the relationship head length — morphologic face height, smallest frontal breadth — bigonial breadth — morphologic face height.

All the above mentioned significant positive correlations are all weak but rather strong positive correlations were obtained for head breadth-bizygomatic breadth; this correlation was significantly higher in males than in females (males, $r = +0.51$: females, $r = +0.77$; $t = 3.0$). Moreover, only in the females did the comparison between head and bizygomatic breadths disclose a significantly higher positive correlation than the other comparisons

between head and face measurements. The correlation between head breadth was significant and weakly positive only in the females, while the relationship between head length and bigonial breadth was significant and weakly positive only in the males.

An examination was made of the shape of the head and face as represented by the length, breadth, fronto-parietal index and the total face index. There were no sex differences between the means for these indices (Table VI); however, a brachycephalic head shape was slightly more common in the

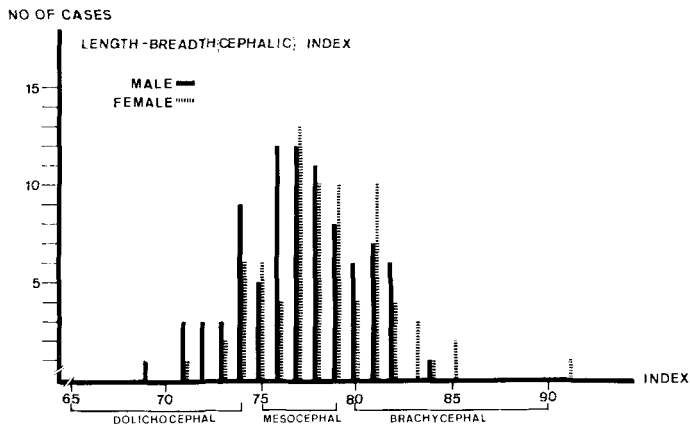


Fig. 2. Diagram showing distribution of male and female cephalic indices. Note the higher frequency of brachycephalic individuals among women and of dolichocephalic among men.

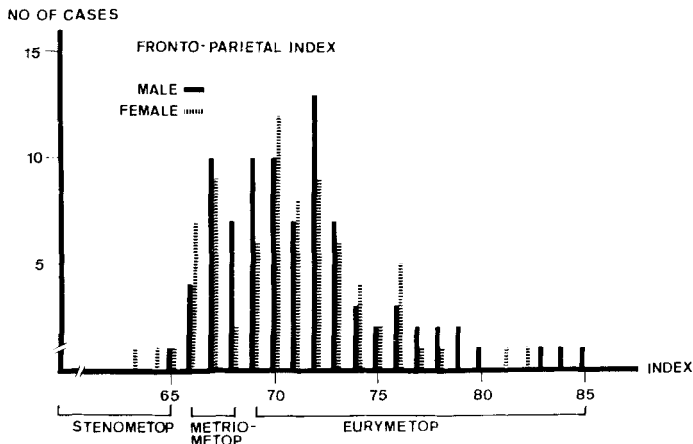


Fig. 3. Diagram showing distribution of male and female fronto-parietal index.

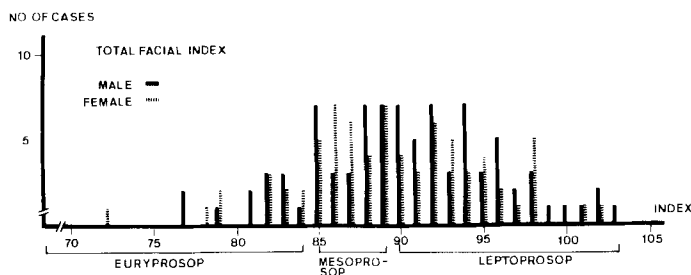


Fig. 4. Diagram showing distribution of male and female total facial index.

women (33 %) than in the men (25 %); only the women showed extremes of this form (Fig. 2). As regards the fronto-parietal index most of the group had a eurymetric head shape (males 74 %, females 73 %; Fig. 3). About one half of the material had a high facial skeleton (leptoprosopic) while only a small number had a low facial skeleton (about 12 %; Fig. 4).

The relationship between, on the one hand, the head and face dimensions and, on the other, the extremity dimensions was examined by product moment correlation analysis; the results are presented in Table VII. Of the head measurements only the smallest frontal breadth showed a significant but weak positive correlation with the radius and tibia lengths; this correlation is, however, not significantly different from those for the head length and breadth *versus* the extremity dimensions. Significant but weak positive correlations were found between almost all the head measurements and skeletal sturdiness (breadth of femoral condyle) in the males. In the females similar weak positive correlation was proved between the smallest frontal breadth and the femoral condyle breadth.

Table VII

Head and face measurements versus length and sturdiness of the extremities

	Length of radius		Length of tibia		Breadth of femoral condyle	
	Males	Females	Males	Females	Males	Females
Head length	0.17	0.12	0.16	0.10	0.31*	0.00
Head breadth	0.13	0.11	0.20	0.20	0.25*	0.07
Frontal breadth	0.23*	0.39*	0.12	0.36*	0.55*	0.39*
Bizygomatic breadth	0.08	0.20	0.07	0.20	0.23*	0.21*
Bigonial breadth	0.11	0.04	0.06	0.08	0.32*	0.23*
Morphologic face height	0.17	0.23*	0.10	0.11	0.20	0.11

*) Significant correlation.

DISCUSSION

The uneven age distribution of the females with an excess of individuals in the interval 35—49 years cannot have any influence on the principle sex differences. The females could have somewhat increased dimensions because of slightly more advanced age changes than the males. Earlier cross-sectional (*Lasker, 1953; Wünsche, 1953*) and semi-longitudinal studies of age changes of cranio-facial dimensions (*Büchi, 1950*) show, however, that the females cannot have gained more than some tenths of a millimeter in their dimensions by age changes in relation to the males. The males on the other hand as represented by more younger individuals may have gained the same amount of increase in their dimensions by the secular trend (*Udjus, 1964*). The size of the dimensional differences between the sexes corresponds well to the size shown in other series (*Lasker, 1953; Wünsche, 1953*). The more brachycephalic tendency among females is nearly an obligate phenomenon in all cranio-facial anthropometry.

The association between the different dimensions showed mostly only weak positive significant correlations. This fact holds good also in other studies (*Lindegård, 1953; Solow, 1966*) and reflects the well-known fact that the growth of head and face is influenced and directed even by many other factors than the adjustment of their separate bones to each other (*Enlow, 1968*).

The rather weak positive or insignificant correlations between the cranio-facial dimensions and the length and sturdiness factors of the extremital bones correspond well to the findings of *Lindegård (1953)*. As the development and growth of head and face only partly follow that of the extremities (*Tanner, 1962; Enlow, 1968*) other findings were not to be assumed.

SUMMARY

A study has been performed of the anthropometry of the head and face in a randomly selected group of males and females aged 25—49 years — employees at a Swedish industrial company. The measurements were performed by the method of *Martin-Saller (1957)*. The standard error of the mean was ± 0.8 — 1.2 mm.

The results of these studies are reported in tabular form. The results of the statistical analyses are given in the tables. These analyses relate to the means and standard deviation (S.D.) for linear head and face measurements, the product moment correlation for the relationship between the craniofacial measurements, and between these and the extremity dimensions. In the

commentaries to the tables comparisons have been made between males and females in the present material and between the present results for mature adult and those obtained by other authors in craniometric studies. The biologic significance of the observed differences in these comparisons has been discussed.

RÉSUMÉ

ÉTUDE ANTHROPOMÉTRIQUE DE LA TÊTE ET DE LA FACE CHEZ DES ADULTES MÛRS DE SUÈDE

Une étude sur l'anthropométrie de la tête et de la face a été faite dans un groupe prélevé au hasard et composé de sujets des deux sexes âgés de 25 à 49 ans, employés dans une entreprise industrielle suédoise. Les mesures ont été effectuées suivant la méthode de *Martin-Saller* (1957). L'erreur standard de la moyenne était $\pm 0,8-1,2$ mm.

Les résultats obtenus sont indiqués sous forme de tableaux. Les résultats des analyses statistiques sont donnés dans les tableaux. Ces analyses concernent les moyennes et écart-type (S.D.) trouvés pour les mesures linéaires de la tête et de la face, la corrélation immédiate trouvée pour le rapport entre les mesures crânio-faciales, et entre ces mesures et les dimensions des extrémités. Les tableaux sont accompagnés de commentaires présentant des comparaisons entre les deux sexes dans ce matériel, et entre les résultats obtenus ici pour les adultes mûrs et ceux obtenus par d'autres auteurs au cours d'études crânio-métriques. Les auteurs discutent la signification biologique des différences observées dans ces comparaisons.

ZUSAMMENFASSUNG

EINE ANTHROPOMETRISCHE STUDIE VON KOPF UND GESICHT IN EINER GRUPPE VON ERWACHSENEN SCHWEDEN

Eine anthropometrische Studie von Kopf und Gesicht in einer zufällig ausgewählten Gruppe von Männern und Frauen im Alter von 25—49 Jahren, alles Angestellte in einer schwedischen Industriefirma, wurde gemacht. Die Messungen wurden ad modum *Martin-Saller* (1957) ausgeführt. Der Standardfehler des Mittelwertes betrug $\pm 0,8-1,2$ mm.

Die Resultate von diesen Studien und die Resultate der statistischen Analysen sind in den Tabellen gegeben. Diese Analysen beziehen sich auf die Mittelwerte und Standardfehler (S.D.) der Kopf- und Gesichtsmasse, die Produktmomentkorrelation der Relation zwischen den kraniofacialen Massen und zwischen diesen und den Extremitätsdimensionen. In den Kommenta-

ren der Tabellen wurden Vergleiche zwischen Männern und Frauen aus vorliegendem Material gemacht sowie zwischen vorliegenden Resultaten und von solchen, die andere Verfasser in kranio-metrischen Studien erhalten haben. Die biologische Signifikanz der beobachteten Unterschiede aus diesen Vergleichen wurde diskutiert.

REFERENCES

- Björk A.*, 1947: The face in profile. *Svensk tandläk.-tidskr.*, 40: Suppl. 5 D, Lund.
- 1955: Facial growth in man, studied with the aid of metallic implants. *Acta Odont. Scand.*, 13:9.
- Büchi E. C.*, 1950: Änderungen der Körperform beim erwachsenen Menschen. *Anthropologische Forschungen. Anthropol. Gesell. Heft 1*, Horn, Wien.
- Enlow D. H.*, 1968: The human face. Hoeber Med. Div. Harper & Row, Publ. N.Y.
- Lasker G. W.*, 1953: The age factor in bodily measurements of adult male and female Mexicans. *Human Biology*, 25:50.
- Lewin T.*, 1969: Anthropometric Studies on Swedish Industrial Workers when Standing and Sitting. *Ergonomics*, 12:883.
- Lindegård B.*, 1953: Variations in human body-build. A somatometric and X-ray cephalometric investigation on scandinavian adults. *Acta Psych. et Neurol.*, Suppl. 86.
- Martin R. & K. Saller*, 1957: *Lehrbuch der Anthropologie*. G. Fischer Verl., Stuttgart.
- Sarnäs K. V.*, 1959: Inter- and intra-family variations in the facial profile. *Odont. Revy*, 10, Suppl. 4.
- Solow B.*, 1966: The pattern of craniofacial associations. *Acta Odont. Scand.*, 24: Suppl. 46.
- Tanner J. M.*, 1962: *Growth of adolescence*. 2nd ed. Blackwell, Oxford.
- Udjus L. G.*, 1964: Anthropometrical changes in Norwegian men in the twentieth century. *Norwegian Monogr. on Med. Sciences Univ. Forl. Oslo*.
- Wünsche H. W.*, 1953: Altersveränderungen metrischer Merkmale in der Kindheit und beim Erwachsenen, sowie ihre Beziehungen zum sozialen Milieu und zum Habitus. *Z. Morph. Anthropol.* 45:368.

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