

Secular Trends of the Face and Stature

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There has been a tendency during the past hundred years for the onset of adolescence, as exemplified by the growth spurt, to take place earlier. Data on heights and weights of school age children indicate that at all ages the stature of children born in the last decade, for instance, is greater than that of those born at the beginning of this century.^{5,6,9,16,20,30,31} Furthermore, there is evidence to suggest that the secular trend in stature is concentrated between the ages of 8 - 14 years.²³

Secular changes appear to be associated with stature rather than bodily proportions, as far as can be judged from the relatively meager data available for measurements other than height and weight.^{17,20} For instance, from an examination of German school children, aged 10 - 17 years, Lenz and Ort¹⁵ noted that weight, arm circumference and chest circumference were virtually identical at any given height between the years 1877 and 1957, despite marked secular trends in height.

In order to augment the information relating to secular changes, therefore, stature and facial dimensions were compared between two London samples of school children, one taken in 1932 and the other in 1971.

MATERIALS AND METHODS

In 1932 Smyth and Young²⁵ measured stature and facial dimensions of approximately 1200 children from London County Council schools. This was a cross-sectional study based upon approximately fifty males and fifty females at six monthly intervals spanning the age range 8 - 14 years. The criterion for the selection of subjects was the presence of "morphologically normal occlusion." This was defined by:

(a) the ridge of the mesiobuccal cusp of the maxillary first molar occluding with the buccal groove of the mandibular first molar;

(b) all the buccal cusps of the mandibular premolars and molars presenting a lingual relationship to the buccal cusps of their maxillary counterparts;

(c) no excessive overjet of the maxillary over the mandibular incisors.

Hence no account was taken of either general factors, such as physique, medical history or diet, or local factors, such as caries or periodontal disease, provided the occlusal relationship was unaffected.

In order to investigate the possible secular changes in stature and facial dimensions between 1932 and 1971, the same dimensions as defined by Smyth and Young were measured in a cross-sectional study of London school children. This was based upon thirty male and thirty female subjects at yearly intervals between the ages of 8 - 12 years.

The dimensions measured were: 1) stature, 2) body weight, 3) TA-N: transmeatal axis to nasion, 4) TA-M: transmeatal axis to mental point, 5) TA-UIGM: transmeatal axis to upper incisor gingival margin, 6) TA-LIGM: transmeatal axis to lower incisor gingival margin, 7) bizygomatic width: maximum zygomatic width of the face, 8) bigonial width: maximum gonial width of the face, 9) N-SNP: nasion to subnasal point, 10) N-SMP: nasion to submental point, 11) breadth at maxillary first premolar: maximum width of the maxillary arch, as measured between the most buccal crown convexities of corresponding maxillary first premolars (or their deciduous predeces-

TABLE 1. COMPARISON OF STATURE, BODY WEIGHT AND SKULL DIMENSIONS BETWEEN TWO LONDON POPULATIONS:- 1932 and 1971

MALE	DIMENSION	8 yrs.		9 yrs.		10 yrs.		11 yrs.		12 yrs.		Mean Percent. Diff. between 8 - 12 yrs.	
		\bar{x}	SE	\bar{x}	SE	\bar{x}	SE	\bar{x}	SE	\bar{x}	SE		
	Stature (cms)	1932	124.0	0.71	128.7	0.68	123.9	0.78	137.1	0.72	142.3	0.68	13.7
		1971	139.6	0.48	147.4	0.77	139.6	0.81	145.2	0.68	151.3	0.72	8.0
	Percent. Diff.		11.9*		13.6*		4.2*		5.8*		6.1*		
	Body weight (Kg)	1932	24.8	0.28	27.8	0.34	30.0	0.37	31.9	0.37	36.6	0.49	38.4
		1971	26.7	0.48	29.4	0.39	34.1	0.46	36.2	0.49	39.0	0.71	37.4
	Percent. Diff.		7.3*		5.4*		12.8*		12.9*		6.3*		
	TA-N (mm)	1932	86.2	0.40	88.0	0.43	89.0	0.46	89.3	0.48	90.7	0.43	5.1 ¹
		1971	87.4	0.63	89.4	0.49	90.4	0.71	91.4	0.65	93.5	0.81	6.7
	Percent. Diff.		1.3		1.6		1.5		2.3		3.0		
	TA-MP (mm)	1932	97.6	0.51	101.2	0.52	101.9	0.56	103.0	0.58	105.0	0.61	7.3
		1971	98.5	0.37	102.2	0.29	103.4	0.49	106.4	0.71	107.1	0.78	8.4
	Percent. Diff.		0.9		1.0		1.5		3.2		2.0		
	TA-UIGM (cms)	1932	85.6	0.47	88.3	0.48	88.7	0.49	89.4	0.57	91.3	0.52	6.4
		1971	86.2	0.38	89.3	0.52	89.8	0.51	90.7	0.69	92.4	0.67	6.9
	Percent. Diff.		0.7		1.1		1.3		1.4		1.2		
	TA-LIGM (cms)	1932	85.8	0.47	88.7	0.50	89.4	0.48	90.1	0.54	91.5	0.52	6.4
		1971	86.4	0.49	89.2	0.71	89.9	0.26	90.5	0.59	92.7	0.61	7.0
	Percent. Diff.		0.7		0.6		0.6		0.5		1.3		
	Bizygomatic Breadth (mm)	1932	120.0	0.41	121.4	0.40	122.7	0.47	123.7	0.44	125.6	0.39	4.6
		1971	120.4	0.36	122.3	0.42	123.2	0.51	124.4	0.63	127.5	0.57	5.7
	Percent. Diff.		0.3		0.7		0.4		0.6		1.6		
	Bigonial Breadth (mm)	1932	96.2	0.41	97.9	0.43	97.8	0.38	99.3	0.41	100.5	0.43	4.4
		1971	96.2	0.37	98.1	0.38	98.2	0.47	99.6	0.52	101.0	0.57	4.9
	Percent. Diff.		0.0		0.2		0.4		0.3		0.5		
	N-SNP (mm)	1932	41.4	0.36	42.4	0.40	42.9	0.30	43.6	0.30	44.4	0.34	7.0
		1971	41.4	0.21	42.6	0.48	43.0	0.47	43.7	0.63	45.0	0.68	8.3
	Percent. Diff.		0.0		0.3		0.2		0.4		1.3		
	N-SMP (mm)	1932	98.4	0.52	100.8	0.57	101.5	0.45	103.6	0.48	103.2	0.52	4.8
		1971	99.2	0.61	102.0	0.63	102.6	0.47	104.1	0.49	104.4	0.63	5.1
	Percent. Diff.		0.8		1.2		1.1		0.5		1.1		
	Breadth @ Maxillary 1st Premolar	1932	43.4	0.22	44.1	0.25	44.5	0.27	45.4	0.25	45.9	0.29	5.6
		1971	43.5	0.29	44.6	0.31	45.2	0.29	45.7	0.41	46.2	0.46	6.0
	Percent. Diff.		0.2		1.2		1.6		0.8		0.7		
	Breadth @ Mandibular 1st premolar	1932	38.1	0.21	39.0	0.22	38.6	0.24	40.0	0.22	40.1	0.24	5.1
		1971	38.8	0.41	39.5	0.39	39.9	0.28	40.4	0.46	40.4	0.44	4.0
	Percent. Diff.		1.8		1.3		3.5		0.8		0.9		

FEMALE	DIMENSION	8 yrs.		9 yrs.		10 yrs.		11 yrs.		12 yrs.		Mean Percent. Diff. between 8 - 12 years	
		\bar{x}	SE	\bar{x}	SE	\bar{x}	SE	\bar{x}	SE	\bar{x}	SE		
	Stature (cms)	1932	123.3	0.65	127.7	0.66	131.8	0.85	136.3	0.83	143.5	0.70	15.1
		1971	124.8	0.96	128.4	0.83	134.3	0.31	140.4	0.84	147.3	0.74	16.5
	Percent. Diff.		1.2		0.5		1.8		3.0		2.6		
	Body weight (Kg)	1932	24.5	0.38	26.4	0.34	28.0	0.38	32.0	0.56	36.3	0.49	38.8
		1971	25.3	0.66	28.6	0.41	31.5	0.43	35.3	0.38	38.3	0.52	40.9
	Percent. Diff.		3.0		8.2		11.7*		9.8		5.5		
	TA-N (mm)	1932	84.9	0.36	84.6	0.46	86.5	0.41	87.8	0.47	89.0	0.47	4.7
		1971	85.9	0.29	86.4	0.35	87.1	0.38	89.1	0.46	90.0	0.44	4.7
	Percent. Diff.		1.1		2.0		0.7		1.5		1.1		
	TA-MP (mm)	1932	96.3	0.51	98.0	0.53	99.6	0.46	101.5	0.63	103.5	0.61	7.2
		1971	97.2	0.27	99.0	0.28	101.0	0.31	102.1	0.46	105.4	0.52	8.1
	Percent. Diff.		1.0		0.9		1.4		0.6		1.8		
	TA-UIGM	1932	84.1	0.42	85.0	0.50	86.3	0.49	88.2	0.60	89.4	0.46	6.1
		1971	85.0	0.70	85.7	0.83	86.8	0.49	89.1	0.84	89.8	0.71	5.5
	Percent. Diff.		1.1		0.8		0.6		1.0		0.4		
	TA-LIGM	1932	84.5	0.40	85.7	0.47	86.9	0.46	88.5	0.57	89.7	0.45	6.0
		1971	85.1	0.56	86.2	0.58	87.4	0.34	89.1	0.49	90.2	0.60	5.8
	Percent. Diff.		0.7		0.6		0.6		0.7		0.6		
	Bizygomatic Breadth (mm)	1932	117.7	0.41	119.1	0.39	120.1	0.42	121.1	0.52	123.6	0.44	4.9
		1971	118.2	0.61	120.1	0.44	121.7	0.71	122.5	0.69	124.9	0.52	5.5
	Percent. Diff.		0.4		0.9		1.3		1.1		1.1		
	Bigonial Breadth (mm)	1932	94.0	0.40	94.9	0.36	95.9	0.37	96.6	0.45	98.2	0.42	4.4
		1971	95.1	0.46	96.0	0.39	96.9	0.47	97.3	0.49	99.8	0.44	4.8
	Percent. Diff.		1.2		1.2		1.0		0.7		1.6		
	N-SNP (mm)	1932	40.1	0.32	41.3	0.30	42.1	0.32	42.8	0.29	43.2	0.30	7.4
		1971	41.1	0.71	42.4	0.67	42.7	0.59	43.1	0.63	43.6	0.28	5.9
	Percent. Diff.		2.6		2.6		1.4		0.7		0.9		
	N-SMP (mm)	1932	96.1	0.58	97.1	0.45	98.3	0.44	101.2	0.51	101.8	0.48	5.8
		1971	97.3	0.69	98.4	0.52	99.7	0.51	103.1	0.64	103.8	0.68	6.5
	Percent. Diff.		1.2		1.3		1.4		1.9		2.0		
	Breadth @ Maxillary 1st Premolar	1932	42.1	0.21	42.7	0.19	43.4	0.22	44.1	0.26	44.6	0.25	5.8
		1971	43.2	0.39	43.9	0.36	44.7	0.47	45.0	0.52	46.1	0.63	6.5
	Percent. Diff.		2.6		2.6		2.9		2.2		3.4		
	Breadth @ Mandibular 1st Premolar	1932	37.1	0.19	37.5	0.20	38.3	0.19	39.0	0.23	39.1	0.19	5.2
		1971	37.3	0.52	38.1	0.61	39.0	0.74	39.2	0.62	40.1	0.84	7.2

\bar{x} = mean (to the nearest decimal place) SE = standard error *statistically significant difference between 1932 and 1971 data (P = < 0.02)

sors) on each side of the dental arch and 12) breadth at mandibular first premolar: maximum width of the mandibular arch, as measured between the most buccal crown convexities of corresponding mandibular first premolars (or their deciduous predecessors) on each side of the dental arch.

As far as could be ascertained, these dimensions were measured in an identical manner to that described by Smyth and Young. There was, however, no method of estimating the error of the measurement technique of Smyth and Young. For the 1971 data the dimensions of fifteen male and fifteen female subjects, selected at random, were measured five times by two independent observers. The error of the measurement technique was less than 2% which proved statistically insignificant ($P > 0.2$) from analysis of variance.

RESULTS

The dimensions of the school children measured in 1971 are summarised in Table I along with the data relating to the 1932 sample. In general, stature and facial dimensions were greater for the 1971 than 1932 samples at all ages. In contrast, the annual increments between 8 and 12 years of age were approximately the same for both sexes in each of the two samples. For instance, between 8 - 12 years, the average increase in body weight was 38.6% for the 1932 sample and 39.2% for the 1971 sample, the average change in stature being 14.4% and 12.3%, respectively.

Compared with stature and body weights, the increments in facial dimensions were of a much lower order of magnitude, the incremental changes in males and females being approximately the same. The over-all change in facial dimensions was 5.5% for males and 5.7% for females between the ages of 8 - 12 years for the 1932 sample, the values for the 1971 sample being 6.2%

and 6.1%, respectively. The dimensions of face length (TA-N, TA-MP, TA-UIGM and TA-LIGM) increased on average by 6.2% in 1932 and 6.6% in 1971 during this age range, the respective figures for face width (bizygomatic and bigonial) being 4.6% and 5.5%, and face height (N-SNP and N-SMP) being 6.3% and 6.5%. Furthermore, the average change in maxillary and mandibular arch width between 8 - 12 years was 5.5% for 1932 and 6.0% for the 1971 sample.

Table II lists the correlation coefficients between stature and facial dimensions for the two population samples. These correlation coefficients were only slightly less for the 1971 compared with the 1932 population samples. Similarly, from comparison of the coefficients between the various facial dimensions, no significant difference in the degree of correlation was apparent between the two samples.

DISCUSSION

In this investigation the stature and facial dimensions were not directly comparable between the 1932 and 1971 population samples, since (a) the 1932 and 1971 samples were neither of equal size nor based upon homogeneous population samples, and (b) the various dimensions were not measured by the same observers, and so were subject to different sources of error. Furthermore, Smyth and Young included the age range 8 - 14 years, whereas only the age range 8 - 12 years was included in this investigation. Nevertheless, the data were regarded as sufficiently comparable to warrant over-all conclusions concerning the general trends of the comparisons.

Until recently, secular trends appeared to be continuing unabated^{6,12,21} although Bakwin and McLaughlin² considered that such changes might be coming to an end. The present data,

TABLE II
CORRELATION COEFFICIENTS BETWEEN STATURE AND
FACIAL DIMENSIONS

Dimension	Male		Female	
	1932	1971	1932	1971
TA-N	0.49	0.43	0.61	0.60
TA-MP	0.60	0.54	0.71	0.61
TA-UIGH	0.47	0.41	0.59	0.53
TA-LIGM	0.48	0.46	0.62	0.60
Bizygomatic Breadth	0.55	0.49	0.64	0.62
Bigonial Breadth	0.45	0.40	0.50	0.49
N-SNP	0.41	0.38	0.42	0.40
N-SMP	0.56	0.47	0.56	0.52
Breadth at Maxillary 1st premolar	0.41	0.38	0.44	0.45
Breadth at Mandibular 1st premolar	0.40	0.44	0.48	0.47

however, showed secular changes in both stature and facial dimensions with no evidence to suggest a decline. Furthermore, the annual increments in both stature and facial dimensions were similar in magnitude in both population samples between the age range 8 - 12 years. This tended to support the views of Tanner^{26,27} that secular changes are the result of earlier maturation.

A considerable amount of data has been amassed relating to facial growth.^{3,4,7,11,14,18,22} There is, in contrast, little information concerning secular trends in facial dimensions. The data of this investigation showed that, although of smaller magnitude than stature and body weight, secular changes did occur in facial dimensions. This tended to confirm the data of Garn, Lewis and Walenga¹⁰ who noted small changes in tooth size over two generations.

Secular trends have been noted in a variety of populations.^{2,13,24,28} Such changes are generally considered to be related to dietary factors.^{1,32} In contrast, Craig⁸ contends that both social and genetic factors are responsible. In this investigation both 1932 and 1971 samples were derived from varying socio-economic backgrounds, so that it

was not possible to identify the main predisposing factor.

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