A Metric Analysis Of The Facial Profile*

WILLIAM D. BOWKER, D.D.S., M.S. and
HOWARD V. MEREDITH, Ph.D.
Iowa City, Iowa

This investigation pertains to the integumental profile of the face in childhood. It describes a quantitative method for depicting the facial profile and presents a number of findings from application of the method.

The integumental profile is measured with respect to a line passing through nasion and pogonion. Distances perpendicular to this line are measured, these distances terminating anteriorly at selected points on the facial profile. Supplementary data are obtained to determine (a) positional relations among the measures perpendicular to the nasion-pogonion-line, and (b) the angular relation of the nasion-pogonion line to a cranial-base line.

The measures are obtained from *norma lateralis* radiographs of the head taken on North American white children. Each of 26 girls and 22 boys are studied at two postnatal ages nine years apart.

STATEMENT of OBJECTIVES

Specific aims of the study were:

1. To devise a metric method for describing the integumental profile of the face and to investigate reliabilities for various facets of the method.

2. To investigate age, sex, and individual differences in the integumental profile of the face. Basic in the realization of this objective were computations of univariant statistics for (a) measurements of the integumental profile at ages 5 and 14 years, and (b) changes in the integumental profile between ages 5 and 14 years.

3. To study associations between components of the integumental profile. This entailed determining bivariant statistics for different aspects of the profile at ages 5 and 14 years, giving particular attention to (a) size at age 5 years in relation to change between 5 and 14 years, and (b) association between age changes in different profile components.

PERTINENT LITERATURE

The literature pertaining to facial size and form was examined in an effort to locate previous research on the integumental profile of the face. Search was made for methodologic proposals and reported findings on children and adolescents.

Five relevant publications were found, two[2, 3] presenting methods of describing the facial profile, one[10] dealing with age and sex differences for height and depth measures of the profile, and two[1,6] reporting findings on change with age in the angle between a facial-height line and a cranial-base line.

Elsasser[3] constructed a facial orthometer that provided a reference axis anterior to the profile and at right angles to the Frankfort plane. Direct measurements were proposed (a) from the axis posteriorly to three points on the integumental profile, i.e., points estimated to lie in the same horizontal planes as nasion, subnasale and pogonion, also (b) along the axis from the estimated level of nasion to sub-

* Supported in part by a research grant, D-217, from the National Institute for Dental Research, of the National Institutes of Health, Public Health Service.

nasale and to the lowest point on the integumental chin.

A method of studying the facial profile on *norma lateralis* radiographs was developed by Burstone.[2] This proposal calls for the determination of series of angles (a) between pairs of lines drawn to selected points along the integumental profile and (b) between lines along the profile paired with a line passing through the anterior and posterior nasal spines.

Pelton and Elsasser,[10] utilizing the Elsasser orthometer, derived two measures each of the forward and downward growth of the integumental profile. They amassed and analysed data for these measures on 3,676 white males and 3,153 white females between 5 and 25 years of age.

Bjork[1] and Lande[6], each studying males only, determined the angle between a facial-height line and a cranial-base line at different ages separated by approximately nine years. The means of Bjork are based on cross-sectional data, those of Lande largely on longitudinal data. Lande studied 20 boys at age 3 years and 32 boys at age 12 years; Bjork's samples numbered 322 at age 12 years and 281 in young adulthood.

The Elsasser and Burstone publications are cited for their methodologic relevance. Findings from the investigations of Pelton and Elsasser, Lande, and Bjork are pertinent for later comparison with findings from the present study.

Subjects

The subjects were 48 American-born white children, 26 girls and 22 boys. All were normal, healthy children participating in a longitudinal research program at the State University of Iowa.* The children were enrolled for study on the basis of willingness to cooperate and the likelihood of continued residence in the vicinity. They were not selected on the basis of facial characteristics or orthodontic needs.

Ninety-six per cent of the subjects had at least two grandparents of northwest European descent. For 76 per cent of the subjects, all four grandparents were of northwest European ancestry.

Seventy per cent of the fathers held professional or major managerial positions. Over 20 per cent were in the minor managerial, commercial or skilled trade groups, and the remainder were employed at semiskilled occupations.

Source of Data

The source of all data was *norma lateralis* radiographs of the head, drawn from the files of the Facial Growth Study.* In this Study radiographs of every subject are taken on or near each birth anniversary, and at semiannual intervals up to 12 years of age.

Those subjects included in the present investigation were required to satisfy the following criteria:

1. Radiographs on file at ages 5 and 14 years, each showing good soft tissue definition.
2. Molar teeth in occlusion.
3. Lips in contact, or nearly so. The latter was accepted when, from examination of serial radiographs, slight lip separation was considered the normal position for the child.

Landmarks and Measurements

Osseous landmarks used in determining the reference and cranial-base lines were:

1. Nasion, defined as the most anterior point of the frontonasal suture.[5]

*This program, known as the Facial Growth Study, is under the joint direction of E. H. Hixon, Department of Orthodontics, and H. V. Meredith, Child Welfare Research Station.

2. Pogonion, defined as the most anterior point of the mandible found by means of a rule moved at right angles to the mandibular plane.[5]

3. Tuberculum, defined as the most superior point of the anterior outline of sella turcica before the outline turns and continues forward.[12]

A line from nasion to pogonion was drawn on each radiograph. Using a rule moved at right angles to this reference line, five pairs of points were marked with a needle probe. The posterior point of each pair was on the nasion-pogonion line and the anterior point of each pair on the integumental profile. The levels for placement of these points were found by locating:

1. The minimum distance from the nasion-pogonion line to the integumental concavity at the root of the nose.

2. The distance from the nasion-pogonion line to the tip of the nose.

3. The minimum distance from the nasion-pogonion line to the concavity of the upper lip.

4. The minimum distance from the nasion-pogonion line to the labiomental groove.[11]

5. The distance from the nasion-pogonion line to the most forward point of the convexity of the integumental chin.

These landmarks were used in obtaining two series of linear measurements. The first series represented anteroposterior distances between each pair of points (see Figure 1). The second series represented distances along the nasion-pogonion line; from nasion to the first level, between the first and second levels, and so forth.

The measurements were obtained directly on the marked radiographs by use of a steel tape calibrated in millimeters. All readings were taken with the aid of a magnifying glass and estimated to the nearest 0.1 mm. The calibration of the tape was checked for accuracy against a standard scale.

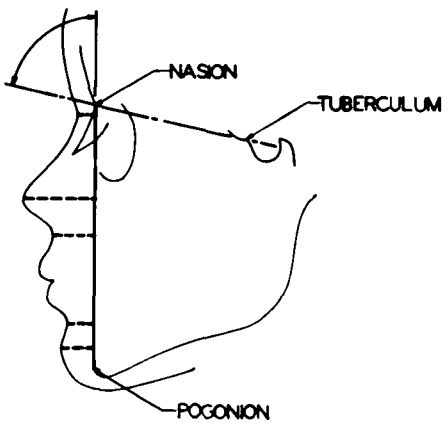

Fig. 1 Illustration of the method used for metrically describing the facial profile.

A cranial-base line, drawn through nasion and tuberculum sella, formed an acute angle with the nasion-pogonion line. This angle was measured on each radiograph by means of a calibrated drafting machine with a vernier scale. All angles were measured to the nearest minute.

Reliability of Data

Two problems pertaining to the reliability of the data were investigated. Both were studied on the 26 female subjects and dealt with distances from the nasion-pogonion line to the facial profile.

The first problem considered the agreement of two measurers, working independently, in determining the distances between the pricked anterior landmarks on the integumental profile and the pricked posterior landmarks on the nasion-pogonion line. Each distance was measured to the nearest 0.1 mm, and all five distances were determined at ages 5 years and 14 years. The extent to which a record obtained by measurer A differed from the corresponding record obtained by measurer B was determined.

Over the entire series, this gave 260 difference values. The standard deviation for these values was 0.10 mm, and the standard error of measurement 0.07 mm.[1]

The foregoing analysis treats one phase of the dependability of the data, i.e., chance variation in measuring between the points registered on the radiographs. Additional chance variation is associated with positioning the subject, radiographic processing, drawing the nasion-pogonion line, and registering the measurement landmarks. For the study of these sources of unreliability, the desirable materials would be several independently obtained radiographs for each subject representing the same age. Since only single radiographs were available for a given age, it was necessary to employ a substitute procedure.

For each subject, single radiographs were on file at semiannual ages from 4.5 years to 11.5 years, and at annual ages from 12 years on. It was decided to investigate reliability using pairs of radiographs taken at a specified age and six months later. Two growth stages were selected, 5.0-5.5 years and 11.0-11.5 years. The 26 female subjects were studied at both stages.

Each radiograph was dealt with by following the same series of steps as were projected for deriving the basic data to be used in the study. These steps have been described to the point of independent measurement of the five dimensions from the nasion-pogonion line to the facial profile. When the two records for a dimension differed by no more than 0.2 mm, their mean was employed. When the difference between the two records was 0.3 mm or more, two additional measurements were taken, the most divergent of the four was discarded, and the mean of those remaining was employed. The composite values for each dimension were corrected for radiographic enlargement.[9]

Analysis by age-level and specific dimension gave the reliability estimates presented in Table I. Each correlation coefficient depicts the association between corresponding measurements of a facial dimension derived from two radiographs taken six months apart. It will be seen that eight of the ten r's are 0.9 or higher.

Findings

The findings of the study will be presented under four captions: profile distances measured perpendicular to the nasion-pogonion line, profile distances measured along the nasion-pogonion line, angular relationship of

Table I

Reliability estimates for five dimensions proposed in metrically describing the integumental profile of the face

Dimension	r 5.0-5.5 years	r 11.0-11.5 years
Nasion-pogonion line to:		
Root of nose	.92*	.91*
Tip of nose	.93	.98
Concavity of upper lip	.90	.96
Labiomental groove	.85	.93
Convexity of chin	.72	.96

* In each instance, N=26 female subjects.

Table II

Central tendency and variability values (mm) for five distances from the nasion-pogonion line to the facial profile

Level of Dimension	Sex	N	Age 5 years Mean	Age 5 years S.D.	Age 14 years Mean	Age 14 years S.D.
Root of nose	Girls	26*	6.3	0.8	6.6	0.8
	Boys	22*	6.6	0.7	7.1	0.8
Tip of nose	Girls	26	23.8	1.6	30.9	2.9
	Boys	20**	24.5	2.1	32.0	3.5
Concavity of upper lip	Girls	26	14.5	2.1	16.3	2.6
	Boys	22	14.7	1.6	17.5	2.3
Labiomental groove	Girls	26	9.7	1.5	9.9	1.7
	Boys	22	9.5	1.8	9.5	1.9
Convexity of chin	Girls	26	11.3	1.3	12.3	1.4
	Boys	22	11.4	1.5	12.4	1.6

* For samples of this size, the range of a distribution approximates the S.D. (standard deviation) multiplied by 3.8.

** Two radiographs did not include the tip of the nose at age 14 years.

the nasion-pogonion line to a cranial-base line, and selected illustrations of individual differences in facial profile.

The basic values for distances along the nasion-pogonion line were derived by the same measurement and adjustment procedures as those for the distances perpendicular to the nasion-pogonion line.

On no radiograph did two independent measures of the pogonion-nasion-tuberculum angle differ by more than 0.3 degree. Values for analysis were obtained by averaging each pair of these measures. Angles require no correction for radiographic enlargement.[13]

Profile distance measured perpendicular to the nasion-pogonion line. Table II displays central tendency and variability values for five distances from the nasion-pogonion line to the facial profile. Separate analyses are shown for children of each sex at ages 5 years and 14 years. The statistics of this table support the following findings:

1. Mean distances perpendicular to the nasion-pogonion line are (a) shorter to the root of the nose than to the labiomental groove, and (b) shorter to the most anterior point of the convexity of the integumental chin than to the most posterior point of the concavity of the upper lip.

2. At 5 years of age, both sexes combined, the obtained means for perpendicular distances from the nasion-pogonion line to the integumental profile are 6.4 mm at the root of the nose, 9.6 mm at the labiomental groove, 11.3 mm at the convexity of the chin, 14.6 mm at the concavity of the upper lip, and 24.1 mm at the tip of the nose.

3. All of the differences between corresponding means for the two sexes are under 1.0 mm at 5 years of age, and under 1.5 mm at 14 years of age. In no instance does a sex difference in standard deviation exceed 0.6 mm. At age 5 years, for none of the five dimensions is there a statistically significant difference between the distributions on girls and boys. At age 14 years, the only statistically significant difference is that between the means

for distance from the nasion-pogonion line to the root of the nose ($t = 2.0$).[4]

In several instances, the statistics presented in Table II suggest an increase in central tendency and/or variability with age. By pooling the data for the two sexes, larger N's were obtained for testing the dependability of age changes. Changes in central tendency significant at the 1 per cent level of confidence[7] are found for the distances from the nasion-pogonion line to the root of the nose, the tip of the nose, the concavity of the upper lip, and the convexity of the chin. The only dimensions for which the magnitude of the increase between ages 5 and 14 years exceeds 1.0 mm are those from the nasion-pogonion line to the deepest concavity of the upper lip (2.3 mm) and from the nasion-pogonion line to the tip of the nose (7.3 mm). The latter dimension stands alone in yielding a statistically significant difference in variability with age.[4]

Since the same sample was studied at ages 5 and 14 years, the data of this section could be utilized to investigate the following relationships: (a) association between the magnitude of a given dimension at 5 years and the change in this dimension over the period 5 to 14 years, and (b) association between the change in a given dimension over the period 5 to 14 years and the change in another dimension during the same period of childhood. Correlation coefficients symbolizing both types of relationship are assembled in Table III. Inspection of this table shows:

1. For none of the five dimensions is there a strong association between size at age 5 years and change in size during the ensuing nine-year period. The obtained r's all lie between zero and ± 0.4 Size-change concomitance is low positive for the distance from the tip of the nose to the nasion-pogonion line, and low negative for the distances from the root of the nose to the nasion-pogonion line and from the most forward point on the convexity of the integumental chin to the nasion-pogonion line.

2. Over the age interval 5-14 years, the amount of change at one level of the facial profile is not highly related to that at other levels. Moderate positive associations (r's between 0.4 and 0.7) are found for (a) change at the level of the tip of the nose with that at the level of deepest concavity of the upper lip, (b) change at the level of the labiomental groove with that at the level of the anteriormost projection of the integumental chin, and (c) change at the level of deepest concavity of the upper lip with that at the level of the labiomental groove.

Profile distances measured along the nasion-pogonion line. Measures along the nasion-pogonion line were obtained for the distance from nasion to the level of the integumental root of the nose; the distances between profile levels 1 and 2, 2 and 3, 3 and 4, 4 and 5; and the distance from nasion to pogonion. These measures were subgrouped according to age, sex and dimension, then analyzed for central tendency and variability. The results are arranged in Table IV. Representative findings are:

1. The mean distance along the nasion-pogonion line from nasion to a perpendicular passing through the root of the integumental nose is greater in early childhood than during adolescence. For both sexes combined, the obtained means are 3.2 mm at age 5 years and 2.0 mm at age 14 years. An appropiate significance test,[7] by supporting rejection of the null hypothesis at the 1 per cent confidence level, allows the inference of a decrease in this dimension with age.

Table III

Relationships among magnitude and increment data for five measures from the nasion-pogonion line to the integumental profile of the face

Measure	N	r	P*
Size at age 5 years with change 5-14 years			
Root of nose	48**	—0.30	<0.05
Tip of nose	46	0.36	<0.05
Concavity of upper lip	48	0.02	...
Labiomental groove	48	—0.18	...
Convexity of chin	48	—0 31	<0.05
Change 5-14 years at different levels			
Root of nose: Tip of nose	46	0.21	...
Tip of nose: Concavity of upper lip	46	0.67	<0.01
Tip of nose: Labiomental groove	46	0.16	...
Concavity of upper lip: Labiomental groove	48	0.43	<0.01
Labiomental groove: Convexity of chin	48	0.67	<0.01
Tip of nose: Convexity of chin	46	0.25	...

* Probability that the population r is zero.

** Children of both sexes.

Table IV

Central tendency and variability values (mm) for six distances along the nasion-pogonion line

			Age 5 years		Age 14 years	
Measurement	Sex	N	Mean	S.D.	Mean	S.D.
Nasion to level 1*	Girls	26	2.8	2.3	1.9	1.6
	Boys	22	3.7	1.8	2.1	2.4
Level 1 to level 2	Girls	26	27.2	2.6	36.9	2.8
	Boys	20**	27.6	3.1	39.1	4.5
Level 2 to level 3	Girls	26	12.5	1.7	17.3	2.0
	Boys	20**	12.6	1.9	18.0	2.1
Level 3 to level 4	Girls	26	29.8	3.4	31.4	3.9
	Boys	22	31.0	3.0	32.9	3.0
Level 4 to level 5	Girls	26	7.4	1.8	10.2	2.5
	Boys	22	8.6	1.9	11.6	2.3
Nasion to pogonion	Girls	26	86.7	4.5	105.5	5.7
	Boys	22	90.4	4.4	111.0	6.5

* The successive levels represent (1) root of the integumental nose, (2) tip of the nose, (3) most posterior point on the concavity of the upper lip, (4) labiomental groove, and (5) most anterior point of the integumental chin.

** Two radiographs did not include the tip of the nose at age 14 years.

2. At age 5 years, mean distances between the successive lines drawn perpendicular to the nasion-pogonion line are, for the two sexes pooled, 27.4 mm, 12.5 mm, 30.4 mm and 8.0 mm. The comparable means at age 14 years are higher by 10.6 mm, 5.1 mm, 1.7 mm and 2.9 mm, respectively. For each of these vertical distances a statistically dependable change with age may be posited, *i.e.*, the hypothesis of no change is untenable at the 1 per cent confidence level.

3. The mean vertical distance between the root and tip of the integumental nose is about 3.0 mm shorter at age 5 years than the mean vertical distance between the deepest concavity of the upper lip and the labiomental groove. At age 14 years the former distance (levels 1 to 2) exceeds the latter (levels 3 to 4) by more than 5.0 mm. It follows that for the age period 5 to 14 years there is much greater vertical increase in the nasal region of the integumental profile than in the labial region.

4. The mean distance from nasion to pogonion is greater for boys than girls. A sex difference significant at the 1 per cent level of confidence is found at each age. With two exceptions, the other differences between corresponding means on boys and girls are not dependable statistically; significance at the 5 per cent level is found for distance from the labiomental groove to the most forward point on the integumental chin at age 5 years, and for distance from the root to the tip of the integumental nose at age 14 years.

5. Combining data on both sexes, the mean distance along the nasion-pogonion line from a perpendicular passing through the root of the nose to a perpendicular passing through the anteriormost point of convexity of the integumental chin is 78.1 mm at age 5 years and 98.4 mm at age 14 years. The portion of this vertical dimension lying above the perpendicular passing through the point of deepest concavity of the upper lip increases from 51 per cent at the earlier age to 56 per cent at the later age. This relative increase harmonizes with findings by Meredith, Knott and Hixon[8] on changes during childhood in the nasal and subnasal components of skeletal face height.

Angular relationship of the nasion-pogonion line to a cranial base line. Table V presents central tendency and variability statistics derived from measures of the acute angle formed on drawing straight lines on each radiograph from pogonion to nasion and from nasion to tuberculum sella. It is found:

1. The means obtained at age 14 years are larger than those obtained at age 5 years by 3.7 degrees and 3.5 degrees on girls and boys, respectively. For both sexes combined, it is possible to reject at the 1 per cent level the hypothesis that the angle does not differ at the two ages.

2. At each age, the mean obtained

Table V

Central tendency and variability values (degrees) for the acute angle pogonion-nasion-tuberculum

Sex	N	Age 5 years		Age 14 years	
		Mean	S.D.	Mean	S.D.
Girls	26	76.4	2.8	80.1	4.2
Boys	22	78.4	4.0	81.9	3.7

on girls is smaller than that obtained on boys. At 5 years a dependable difference is tenable at the 5 per cent level; at 14 years the null hypothesis cannot be rejected.

3. Pooling the data for a given age on both sexes, the obtained means for the angle are 77.4 degrees at age 5 years and 81.0 degrees at age 14 years. It follows that in the 48 children studied the mean increase in pogonion - nasion - tuberculum angle between 5 and 14 years of age is 3.6 degrees.

Comparative reference to radiographic studies by Lande[6] and Bjork[1] is relevant. Lande measured the acute angle formed by drawing lines from gnathion to nasion and from nasion to the center of sella turcica; Bjork measured the acute angle between lines from pogonion to nasion and nasion to the center of sella turcica. The subjects for both investigations were boys.

Lande reports means at ages 3 years and 12 years; Bjork reports means at age 12 years and in early adulthood. In each study, the mean at the older age is 2.8 degrees higher than that at the younger age. Generalizing, findings from Lande, Bjork, and the present study show that over the years from early childhood to early adulthood there is an increase with age in the acute angle between two lines from the region of sella turcica to nasion and from nasion to the region of the anterior margin of the mandible.

Returning to anteroposterior dimensions, it will be recalled that between 5 and 14 years of age the distance from the nasion-pogonion line to the tip of the nose is found to increase much more than the distance from the nasion-pogonion line to the most forward point on the integumental chin (See Table VI, rows 2 and 5). When account is taken of the age change in the pogonion-nasion-tuberculum angle, what may be inferred regarding the forward development of the integumental profile in the lower nasal and chin regions? If the angular increase were due entirely to the movement of pogonion, there would be little difference in amount of forward development of the profile at these two levels. However, it appears unlikely that this extreme assumption with regard to pogonion holds; some downward movement of nasion (See Table 6, row 6) and/or upward movement of tuberculum sella[12] probably occurs. Pelton and Elsasser[19], using a reference line at right angles to the Frankfort horizontal and in contact with the integumental profile near nasion, found that during childhood and adolescence the average North American white boy and girl is characterized by slightly more forward development of the integumental profile in the region of subnasale than in the region of pogonion.

Selected illustrations of individual differences in facial profile. To this juncture, individual variation in the different measures obtained has been denoted numerically in terms of the standard deviation and the Pearson *r* coefficient of correlation. In the present section, three pairs of profiles are placed in juxtaposition for the purpose of providing pictorial examples of individual variation.

Part A of Figure 2 presents the facial profiles of two children (M 2, F 12) 5 years of age. These children were selected to illustrate the range found for the minimum distance from the nasion-pogonion line to the deepest point of the concavity of the upper lip. The child showing the larger criterion measure (F 12) is *above average** in distance from the nasion pogonion line to the tip of the nose,

Table VI

Central tendency and variability values (mm) representing change in twelve measures of the facial profile over the age period from 5 to 14 years

Measurement	Girls: N = 26 Mean	S.D.	Boys: N = 22 Mean	S.D.
Anteroposterior:				
Level 1*	0.3	0.6	0.5	0.6
Level 2	7.1	1.7	7.5**	2.2
Level 3	1.8	1.4	2.8	1.7
Level 4	0.2	1.3	0.0	1.5
Level 5	1.0	1.1	1.0	1.2
Vertical:				
Nasion to level 1	—0.9	1.8	—1.6	2.7
Level 1 to level 2	9.7	2.4	11.5**	3.7
Level 2 to level 3	4.8	2.0	5.4**	2.2
Level 3 to level 4	1.6	3.0	1.9	3.6
Level 4 to level 5	2.8	2.0	3.0	2.0
Nasion to pogonion	18.8	2.8	20.6	5.2
Angle:				
Pogonion-nasion-tuberculum	3.7	3.0	3.5	2.7

* See first footnote below Table IV.
** N = 20

above average in distance from nasion to pogonion, *average* in distance from the nasion-pogonion line to the anteriormost projection of the chin convexity, *below average* in distance from the nasion-pogonion line to the labiomental groove, and below average in pogonion-nasion-tuberculum angle.

Portrayed in part B of Figure 2 are the facial profiles of two children (F 15, F 38) 14 years of age. Those profiles illustrate the range found for the distance from the nasion-pogonion line to the most forward extension of the integumental chin. The child with the smaller criterion measure (F 38) is *below average* in distances from the nasion-pogonion line to the labiomental groove, the deepest point of the concavity of the upper lip, and the anteriormost point on the convexity of the integumental chin. In pogonion-nasion-tuberculum angle, vertical distance from the root to the tip of the nose, and the remaining distances from the nasion-pogonion line to the facial profile this girl closely approximates the *average*. These findings and those in the preceding paragraph were obtained by referring the measurements on individual children to the appropriate group statistics presented in Tables II, IV and V.

In part C of Figure 2, facial profiles are displayed for the same child (M 38) at ages 5 and 14 years. Of the subjects included in the study, this boy exhibits the greatest change in

* As used throughout this section, "above average" denotes that the child falls more than one standard deviation above the mean of the sex-specific distribution for the variable specified. "Below average" implies "more than one standard deviation below the mean."

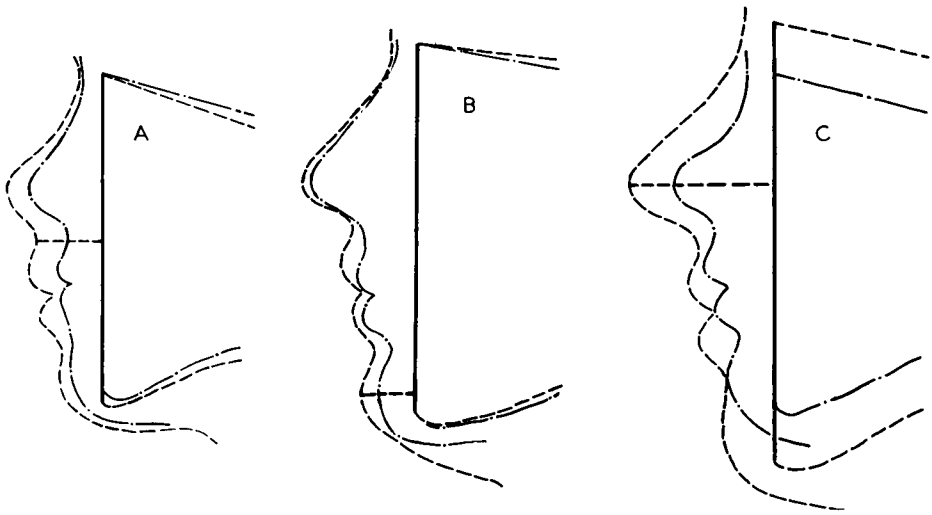

Fig. 2 Selected illustrations of individual differences in integumental profile of the face.

distance from the nasion-pogonion line to the tip of the nose. His increment is almost 60 per cent greater than the mean increment for boys. In other measures the age changes of this boy are *below average* for vertical distance from the tip of the nose to the deepest point of the concavity of the upper lip, *average* for distance from the nasion-pogonion line to the root of the nose, and *above average* for distance from the nasion-pogonion line to the labiomental groove, distance from the nasion-pogonion line to the most forward point on the chin, and vertical distance from the root to the tip of the nose. The group statistics to which the age changes on M 38 were referred are assembled in the right-hand columns of Table VI.

Summary

Early sections of this paper present quantitative procedure for describing the integumental profile of the face and discuss the reliability of data amassed through its use. The procedure necessitates *norma lateralis* radiographs of the head showing good definition of the anterior facial skeleton and the integumental profile. A reference axis is drawn through nasion and pogonion, and from this axis the profile is studied horizontally, vertically and with respect to a cranial-base line.

Later sections of the paper report findings obtained on 48 North American white children each studied at 5 and 14 years of age. Profile variation is investigated for twelve separate measures, with analyses being made for size at age 5 years, change between 5 and 14 years, and size at age 14 years. Associations between aspects of the integumental profile are studied and individual differences in facial profile illustrated.

W-510 East Hall

References

1. Bjork, A.: The Face in Profile. *Svensk Tandlakare-Tidskrift,* 40: No. 5B, 1947.
2. Burstone, C. J.: The Integumental Profile. *Am. J. Ortho.,* 44: 1-25, 1958.
3. Elsasser, W. A.: Studies of Dentofacial Morphology: 1. A Simple Instrument for Appraising Variations. *Angle Ortho.,* 21: 163-171, 1951.

4. Guilford, J. P.: *Fundamental Statistics in Psychology and Education.* McGraw-Hill Book Co., New York, 1950.
5. Krogman, W. M. and Sassouni, V.: *A Syllabus in Roentgenographic Cephalometry.* Center Research Child Growth, Philadelphia, 1957.
6. Lande, M. J.: Growth Behavior of the Human Bony Facial Profile as Revealed by Serial Cephalometric Roentgenology. *Angle Ortho.,* 22: 78-90, 1952.
7. Lindquist, E. F.: *Statistical Analysis in Education Research.* Houghton Mifflin Co., Boston, 1940.
8. Meredith, H. V., Knott, V. B., and Hixon, E. H.: Relation of the Nasal and Subnasal Components of Facial Height in Childhood. *Am. J. Ortho.,* 44: 285-294, 1958.
9. Newman, K. J., and Meredith, H. V.: Individual Growth in Skeletal Bigonial Diameter During the Childhood Period From 5 to 11 Years of Age. *Am. J. Anat.,* 99: 157-187, 1956.
10. Pelton, W. J., and Elsasser, W. A.: Studies of Dentofacial Morphology: IV. Profile Changes Among 6,829 White Individuals According to Sex and Age. *Angle Ortho.,* 25: 199-207, 1955.
11. Sicher, H.: *Oral Anatomy.* C. V. Mosby Co., St. Louis, 1952.
12. Silverman, F. N.: Roentgen Standards for Size of the Pituitary Fossa from Infancy through Adolescence. *Am. J. Roent., Rad. Ther. and Nuc. Med.,* 78: 451-460, 1957.
13. Thurow, R. C.: Cephalometric Methods in Research and Private Practice. *Angle Ortho.,* 21: 104-116, 1951.