Study of relationship between facial index and gestational age in normal newborns

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ABSTRACT

Anthropometric dimensions are the basis of evaluation of health of newborns. Results of cephalometric studies can be used in forensic medicine, plastic surgery, pediatrics, oral surgery, dentistry, otolaryngology and syndromology. Three hundred sixty appropriate for gestational age newborns belonging to the region in and around Patiala were the subjects of the present study. The gestational age varied from 29 to 41 weeks. Face length and face width were measured and facial index was calculated. The overall mean face length and mean face width were 5.17 cm and 6.42 cm respectively. Facial index ranged from 79.3 - 81.4% with mean facial index being 80.5%. Facial index increased with increasing gestational age. Gestational age has negative correlation with face length and face width but positively significant correlation was observed between gestational age and facial index. Facial length and facial width were jointly determined. All inter-relationships improved remarkably when determined for gestational age groups. These findings have significant implication as gestational age linearly influenced facial index. In addition they provide database from 29th to 41st week of gestation and can be used as baseline for further anthropometric studies to specify the role of heredity and environment.

Keywords: Newborns, anthropometry, gestational age, facial index, correlation.

INTRODUCTION

Anthropometric measurements serve as useful adjuncts to other observations in evaluating intrauterine as well as infant growth and development.[1,2] Improvements in the technique of measurements and in the location of landmarks, modification of standard measurements and development of new ones has led to greater use of anthropometry for its reliable and useful application in medicine.[3]

Cranial measurements and indices offer simplest and a fairly accurate way of comparing skulls of different social groups which also help in suggesting shape of skull and doing cranial reconstruction. There are many inherited birth defects associated with abnormal craniofacial development. It is often misleading and imprecise to describe dysmorphic physical findings without accurate quantification.[4]

In growth studies the most common method of collecting data is cross-sectional anthropometry. Normative standards for craniofacial measurements are available for white people and many other communities.[4] The use of white people or other standards may not be applicable to Indian infants as such measurements vary in different populations. Thus there is an urgent need to develop a database of facial anthropometry for different regions so that specific guidelines can be formulated for each region.

Although, anthropometric studies of newborns, their age groups, and its relationship with disease have been performed, there is a scope for research in various geographical and racial groups. Inspite of determination of some anthropometric features such as weight, height and circumference of head, studies on cephalometry have not been carried out. The purpose of our study was to provide a gestational age specific standard for facial index in the region around Patiala in Punjab. These results can be used in forensic medicine, plastic surgery, pediatrics, oral surgery, dentistry, otolaryngology and syndromology.[3,5]

MATERIALS AND METHOD

The present study was conducted on 360 normal newborns born at different gestational ages in Government Medical College and Rajindra Hospital, Patiala. All neonates belonged to similar socio economic status to further decrease the effect of external factors and to make the study highly specific.

Gestational age was calculated from the last menstrual period to the date of delivery. It was compared with the gestational age assessment done by New Ballard scoring

Table-1: Comparison of face length, face width and facial index of newborns at different gestational age

Gestational Age (in weeks)	f	Face Length (cm)		Face Width (cm)		Facial Index (%)	
		mean	SD	mean	SD	mean	SD
29	5	5.34	0.13	6.73	0.19	79.34	1.33
30	11	5.15	0.39	6.48	0.43	79.47	1.21
31	7	5.23	0.42	6.58	0.53	79.48	0.93
32	4	5.19	0.25	6.50	0.28	79.85	1.30
33	7	4.97	0.65	6.17	0.77	80.55	0.90
34	7	5.19	0.43	6.47	0.54	80.22	2.79
35	7	5.18	0.54	6.44	0.53	80.43	2.43
36	10	5.15	0.34	6.42	0.28	80.23	0.96
37	88	5.17	0.44	6.42	0.53	80.53	1.61
38	107	5.18	0.45	6.43	0.52	80.56	1.65
39	76	5.19	0.46	6.44	0.55	80.59	1.73
40	26	5.04	0.29	6.26	0.36	80.51	1.66
41	5	5.35	0.55	6.57	0.75	81.43	1.04
r:		-0.17 (p<0.001)		-0.36 (p<0.001)		0.89 (p=0.01)	

system.[6] The disparity of ± 2 weeks between the gestation recorded by the last menstrual period to the date of delivery and New Ballard scoring system was considered as normal.

Weight of the babies were taken at birth with an electronic weighing machine (marketed by Central Sales Corporation, Chandigarh) having an accuracy of ± 5 grams. The weight of the babies were compared with gestation and accordingly babies were classified into appropriate for gestational age (AGA), small for gestational age (LGA) according to Battalgia *et al*.[7] AGA babies were the subjects of the present study.

Babies with craniofacial abnormalities (cleft palate, cleft lip, micrognathia and others), caput succedanum, cephalhematoma, hydrocephalous, chromosomal abnormalities were excluded.

The various measurements were taken with Martin Spreading calipers after taking an informed consent from the parents/ guardians.

Facial Index was worked out as proportion of face length to face breadth expressed as percentage as follows:

Facial Index = Face Length x100

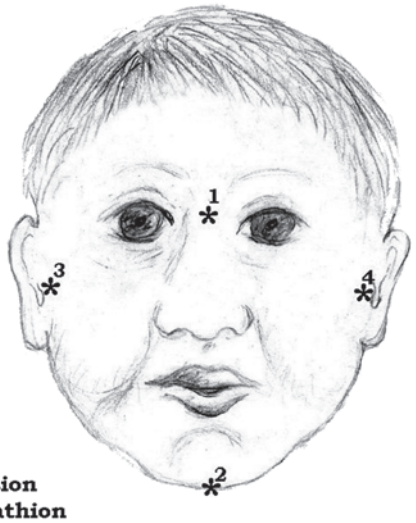
Face Width

Where, Face Length is the distance between nasion and gnathion.

Face width is the bizygomatic breadth (maximum breadth, across the zygomatic arches, wherever found but perpendicular to the median plane)[8]

Facial index is also known as Prosopic Index. Its morphological classification is as follows: [8]

Face Shape	Range of Prosopic Index (%)
Hypereuriprosopic	<79.9
Euriprosopic	80.0-84.9
Mesoprosopic	85.0-89.9
Leptoprosopic	90.0-94.9
Hyperleptoprosopic	>95



1. Nasion
2. Gnathion
3 - 4. Landmarks for face width

Fig. 1. Various landmarks on the face

All measurements were taken within 24 hours of birth and were taken and recorded by the same observer throughout the study. The data for each newborn was recorded in a special form, compiled and then analysed statistically.

OBSERVATIONS

A total number of 360 normal newborns were included in the study. The range of gestation was between 29 and 41 weeks.

The mean face length, face width and facial index along

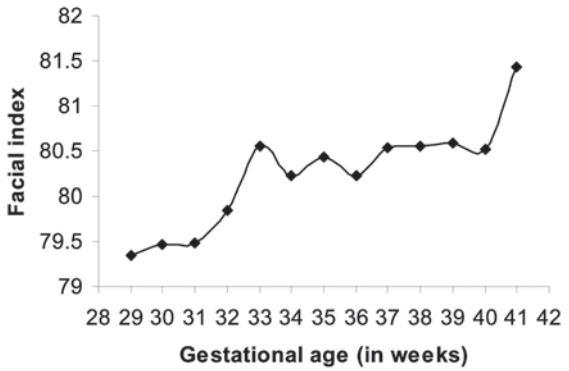


Fig. 2. Variation of facial index with gestational age

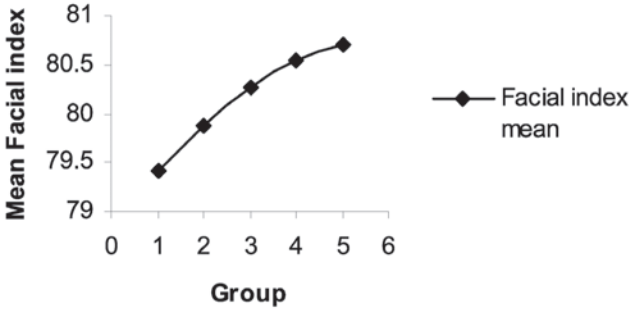


Fig. 3. Variation of facial index with gestational age groups

with frequency (f) of newborns at different gestational age is represented in the Table-1.

The minimum face length and face width was at gestation age of 33 weeks and was 4.97cm and 6.17cm, respectively. The maximum face length (5.35cm) was observed at 41 weeks of gestation and maximum face width (6.73cm) was observed at gestational age of 29 weeks. The overall mean face length and face width were 5.17 cm and 6.42 cm respectively. Facial index ranged from 79.3 - 81.4% with mean facial index being 80.5%. Majority of the newborns were classified as euriprosopic where as only 7.5% were classified as hypereuriprosopic.

It is evident from the table that there is increase in facial index with increasing gestational age. The increase is linear (Fig.1) with very high correlation coefficient of 0.89. Facial length and facial width have highly significant negative association with gestational age (r = -0.17 and r = -0.36 respectively) yet they do not follow any specific pattern like facial index. High positive association (r=0.92) between face length and face width suggests that both face length and face width are interrelated i.e. high face length is associated with high face width and low with low. Both face length and face width are interdependent and jointly determined. This in fact determined the positive correlation of facial index with gestational age.

The dominant face form is Euriprosopic, though the range in variation of facial index with gestational age is very small (Fig. 2).

Frequency of gestational age along with the three parameters was worked out and is presented below in Table-2. This was done to minimize overlapping of gestational age and to have better idea of relationship between gestational age and biometric parameters.

As is evident from Fig. 3, the relationship between facial index and different groups of gestational age is linear, with a very high correlation coefficient (r = 0.98).

DISCUSSION

The human body dimensions are affected by ecological, biological, geographical, racial, gender and age factors. The evaluation and measurement of human body dimensions are achieved by physical anthropometry.[8,9]

Anthropometric dimensions are the basis for evaluation of health and growth of a newborn. Dimensions of a newborn's body can be the basis for all changes in anthropometric indices. Therefore, these dimensions are important in this field because this is one of the newborn health evaluation indices.

Craniofacial anthropometry is important for characterizing facial features and detection of dysmorphic and syndromal craniofacial appearances. They enable quantitative description that is more precise and objective than the current practice of sole reliance on visual impression.[4]

The face length and face width are useful for detection of morphological malformation of the face. The shape of the face can be described by facial index which differentiates between short wide face and long narrow face. The Facial

Table-2: Anthropometric measurements in relation to gestational age groups

Gestational Age (in weeks)	Class	f	Face Length (cm)		Face Width (cm)		Facial Index (%)	
			mean	SD	mean	SD	mean	SD
28 – 30	1	16	5.21	0.32	6.56	0.41	79.42	1.21
31 - 33	2	18	5.12	0.47	6.41	0.60	79.87	1.09
34 – 36	3	24	5.17	0.42	6.44	0.45	80.27	2.03
37 – 39	4	271	5.18	0.45	6.43	0.53	80.55	1.67
40 - 42	5	31	5.09	0.35	6.31	0.43	80.69	1.63
r with gestational age			-0.59		-0.85		0.98	
			p< 0.001		p<0.001		p<0.001	

r Face length and face width : 0.92 (p<0.001)

index increased with increasing gestational age. Face length correlated well with face width and highly positive correlation was observed (r=0.92) was observed. The same was concluded by Fok *et al*[4] in a study on Hong Kong chinese babies of gestational age 33-42 weeks. These findings have significant implication in that we can objectively define facial dysmorphism accurately with these indices even in premature babies in whom identification of dysmorphic features is notoriously difficult. Inspite of best efforts, relationship of Facial index in newborns with gestational age could not be made available on Indian population.

The dominant face morphology is Euriprosopic which is also the dominant face form in adults of this region. The present study provides a database from 29 to 41 weeks of gestation and can be used in anthropological studies to compare term and preterm babies and also on the basis of sex, background and ethnicities.

The present study demonstrates that face length and face width are interdependent and gestational age influences facial index linearly. All the relationships are more pronounced and linear when worked out on groups. These relationships can serve as useful criteria for future anthropometric studies in addition to providing a database for future studies in relation to gestational age and facial index. Hence this study can be used as a baseline study for further efforts to determine the role of heredity, environment, ageing, sex and racial factors on shapes of head and face especially in newborns.

REFERENCES

1. Lubchenco LO, Hansman C, Boyd E. Intrauterine growth in length and head circumference as estimated from live births at gestational age from 26 to 42 weeks. *Pediatr* 1966; 37: 403-8.
2. Bhat GJ, Mukelabai K, Shastri GN, Tamina C. Anthropometric parameters of Zambian infants at birth. *J Trop Pediatr* 1989; 35: 100-4.
3. Banister M. Skeletal system. In: Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE *et al* editors. Gray's Anatomy- The anatomical basis of medicine and surgery 38th ed. London ELBS with Churchill Livingstone Edinburgh; 1998.607-12.
4. Farkas LG, Kolar JC. Anthropometric guidelines in cranio-orbital surgery. *Clin Plastic Surg* 1987; 14: 1-16.
5. Fok TF, Hon KL, So HK *et al*. Facial anthropometry of Hong Kong Chinese babies. *Orthod Craniofac Res* 2003; 6: 164-72.
6. Ballard JL. New Ballard Score Expanded to include extremely premature infants. *J Pediatr* 1991; 119: 417.
7. Battalgia FC, Lubchenco LO. A practical classification of new born infants by weight and gestational age. *J Pediatr* 1967; 71: 159-63.
8. Golalipour MJ, Haidari K, Jahanshahi M, Farahani RM. The shapes of head and face in normal male newborns in South East of Caspian Sea (Iran-Gorgan). *J Anat Soc India* 2003; 52: 28-31.