

Cranio-facial anthropometric study of adult population in Kerala

Prathilash K¹, Thomas Jerry^{2*}, B Umadethan³

¹Assistant Professor, Department of Forensic Medicine & Toxicology, Malabar Medical College Hospital & Research Centre, Ulliyeri, Kozhikode, 673323 Kerala, INDIA.

²Assistant Professor, Department of Forensic Medicine & Toxicology, Sree Narayana Institute of Medical Sciences, Chalakka, Kuthiyathode Po, Ernakulam, Kerala, INDIA

³Formerly Professor And HOD, Department of Forensic Medicine & Toxicology, Amrita Institute of Medical Sciences, Ernakulam, Kerala, INDIA.

Email: drprathilash@gmail.com

Abstract

Background: Craniometric measurements of the skull can identify the skulls of different races based on the cephalic index estimated from the length and breadth of skull. Gender differentiation is also possible from the measurements of skull in addition to the anatomical characteristics to discern sex. Similarly, facial and nasal indices can be determined from the length and breadth of face and nose. These lengths and indices are helpful in differentiating sex as well as the types of face and nose of the study population. In the present study using sliding and spreading digital calipers craniofacial measurements of randomly selected 200 adults (100 males and 100 females) hailing from different regions of Kerala, were taken. The results obtained were statistically analysed and found to be significant.

Key Words: Craniometry, Cephalic index, Dolichocephalic, Mesocephalic, Hyperbrachycephalic, Nasal index, Mesorrhine, Platyrrhine, Leptorrhine, Facial index, Euryprosopy, Mesoprosopy, Leptoprosopy, Hyperleptoprosopy, Hypereuryprosopy.

*Address for Correspondence:

Dr Thomas Jerry, Assistant Professor, Department of Forensic Medicine and Toxicology, Sree Narayana Institute of Medical Sciences, Chalakka, Kuthiyathode Po, Ernakulam, Kerala, INDIA

Email: drprathilash@gmail.com

Received Date: 08/11/2019 Revised Date: 12/12/2019 Accepted Date: 23/01/2020

DOI: <https://doi.org/10.26611/10181422>

Access this article online

Quick Response Code:



Website:

www.medpulse.in

Accessed Date:
22 May 2020

INTRODUCTION

Establishing identity of a living individual or a mutilated or skeletonised dead body sometimes poses problems in medico-legal investigations. The main basic parameters to determine identity are the race/ethnicity, sex age and stature.¹ Determination of the race becomes a material point in identifying mutilated dead bodies in mass disasters like crash of an international airliner where the passengers

may be an admixture of different races of the world.² Racial characteristics are best observed from the measurements of length and breadth of skull and estimating the cephalic index.^{3,4} Based on this the type of head can be determined. From the measurements of the height of nose, breadth of nose, length of face and breadth of face, nasal and facial indices can be calculated. These will help in categorising the type of noses and faces of the population studied. Moreover, these measurements are statistically significant in differentiating the gender.

Objectives of the study

Primary objective was to determine the cranio-facial anthropometric norms of the adult population of Kerala such as shape of head, nose and face.

The secondary objective was to determine the gender differences from the measurements of head, nose and face.

MATERIALS AND METHODS

Present study was undertaken by the Department of Forensic Medicine of Amrita School of Medicine, one of the institutions under the Amrita Institute of health care sector which has a 1450 bedded hospital. There are 6191 people (2208 males and 3983 females) in the campus hailing from different parts of Kerala State. Therefore this study group can be considered as a cross section of the Kerala population. After analysing the previous studies ^{5,6,7} and with 20% allowable error and 95% confidence, minimum sample size was determined to be less than 40 (20 males and 20 females) However using random sample method 200 subjects (100 males and 100 females) were selected from the entire list of study population of the age group between 20-50 years hailing from all the districts. After obtaining written informed consent from the subjects; personal identification, demographic data, medical and surgical history and craniofacial measurements were obtained and recorded in the proforma prepared. Subjects having any congenital or acquired craniofacial malformations were excluded. Using sliding (Fig 1) and spreading digital calipers (Fig. 2), following craniofacial measurements were taken from each subject who was seated comfortably in a chair with the head kept in the anatomical position.



Figure 1. Sliding digital caliper; Figure 2. Spreading digital caliper

Anatomical and anthropological landmarks are marked on the head (Fig. 3). Maximum length of head is the maximum anteroposterior diameter measured from 'Glabella' to 'Inion' (Fig.4). Glabella is an anatomical point just above the root of nose between the eyebrows, intersected by the mid-sagittal plane. Inion is the distal most point placed on the external occipital protuberance (Fig.3). Maximum breadth of head is the distance between two 'Euryons' (Fig.5). Euryon is the point of maximum protuberance in the parietal bones (Fig 3). Cephalic index was calculated by multiplying the breadth of head by 100 and dividing it by the length of head. Depending upon the indices, the types of head were classified (Table 1) as given by Williams (1995).⁸

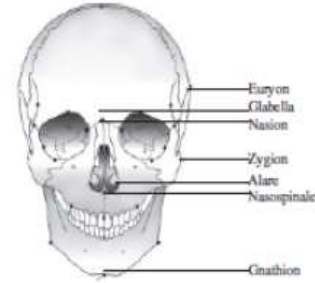


Figure 3: Anatomical and anthropological landmarks of the head



Figure 4

Figure 5

Figure 4: Taking the length of head using the spreading caliper; Figure 5: Taking the breadth of head using the spreading caliper. Height of the nose was measured (Fig. 6) from the 'nasion' to 'subnasale'. Breadth of nose was measured as the maximum breadth at right angle to the nasal height from 'ala' to 'ala' (Fig. 6 A and B). These measurements were taken with digital sliding calipers. Nasion is the point on the root of nose where the mid sagittal plane cuts the nasofrontal suture. Subnasale is the point at which the nasal septum merges with the upper cutaneous lip in the mid sagittal plane. Ala is the prominent point on the lateral wall of the nose. The nasal index was calculated by multiplying the breadth of nose with hundred and dividing it by the height of the nose. On the basis of nasal index, Martin and Sallar (1957) has divided nose into three types ^{8,9,10} Maximum length of face was measured from 'nasion' to 'gnathion'. Maximum breadth of nose was measured between the farthest points on the 'Zygomatic arches' on both sides (Fig. 7 A and B). Nasion is the intersection of the nasofrontal suture with the mid sagittal plane. Nasion is the uppermost landmark for measuring the facial length. Gnathion is the most anterior and lowest median point on the border of mandible. Bizygomatic breadth is between the farthest points on the zygomatic arches. The facial index is calculated by multiplying the length of face with hundred and dividing it by the breadth of face. The facial index was classified on the basis of international descriptions (Williams *et al.* 1995) into five types ^{9,11}. All the measurements and indices were subjected to statistical analysis using SPSS (Statistical package for social sciences) version 20 and various parameters were compared using student 't' test.



Figure 6 A and B: Taking the length (A) and breadth of nose (B) using the sliding caliper

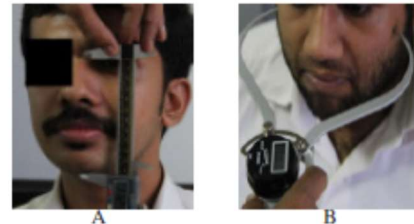


Figure 7 A and B: Taking the length and breadth of face using the sliding caliper

RESULTS

Length of head varied from 160.2 mm to 206.3 mm. When length of head of 100 male subjects was examined, the mean was found to be 189.24 ± 8.06 . In the case of 100 female subjects the mean length of head was $179.42 \pm .07$. When these results were analysed it was found to be statistically significant in determining gender from length of head (p value < 0.0001). Breadth of head varied from 112.3 mm to 167.9 mm. When breadth of head of 100 male subjects was measured, the mean was found to be 144.85 ± 7.53 . In the case of 100 female subjects the mean was $135.43 \text{ mm} \pm 7.90$. These results are statistically significant in determining gender from breadth of head (p value, 0.001) Based on the cephalic indices calculated from the length and breadth of heads, the 200 subjects were categorised into four types based on Williams classification (1995). viz dolichocephalic, mesocephalic brachycephalic and hyperbrachycephalic. The mean cephalic index of 100 males was 76.64 ± 4.45 . When 100 females were studied the mean cephalic index was 75.5 ± 4.73 . When these results were analysed statistically there was no significant gender differentiation (p value < 0.1000) (Table 1)

Table 1. Cephalic index and type of head frequency in the study population

Cephalic Index	Type of bead	Frequency			Percentage
		Male No.	Female No.	Total NO.	
≤ 74.9	Dolichocephalic	42	47	89	44.5
75 to 79.9	Mesocephalic	31	37	68	34.0
80 to 84.9	Brachycephalic	25	12	37	18.5
≥ 85	Hyperbrachycephalic	2	4	6	3.0
Total		100	100	200	100.0

Height of nose varied from 24.86 mm to 59.84mm. The mean height of nose of 100 males in the study group was 48.67 ± 4.51 . The mean height of nose of 100 females was 49.66 ± 4.65 . The results were statistically significant in differentiating the gender. Breadth of nose varied from 18.33 to 47.98 mm. The mean breadth of nose of 100 male subjects was 36.80 ± 3.1 . In the case of 100 female subjects, mean breadth of nose was 35.06 ± 3.62 . This result was statistically significant in determining the gender from the breadth of nose (p value, 0.001). The mean nasal index of 100 males was 76.02 ± 7.32 . In females of the study group, the mean nasal index was 71.01 ± 8.24 . On statistical analysis of the result, there was significant gender differentiation. Based on the nasal indices estimated from the length and breadth of nose, the 100 study subjects were categorised into three types of nose as per the classification of Martin and Sallar (1957) The three types are Leptorrhine, Mesorrhine and Platyrrhine (Table 2).

Table 2: Nasal index and type of nose frequency in the study population

Nasal Index	Type of bead	Frequency			Percentage
		Male No.	Female No.	Total NO.	
≤ 69.9	Leptorrhine	19	51	70	35.0
75 to 84.9	Mesorrhine	3169	42	111	55.5
≥ 85	Platyrrhine	12	7	19	9.5
Total		100	100	200	100.0

Length of face varied from 95.36 to 133.34 mm. The mean length of face of 100 male subjects was 114.37 ± 6.96 . The mean facial length of 100 females was 107.26 ± 4.85 . This result was statistically significant in determining the gender from the breadth of face (p -value, 0.001). Breadth of face varied from 94.1 to 135 mm. The mean breadth of nose of 100 male subjects was 120.39 ± 6.68 . The mean facial length of 100 females was 108.04 ± 6.90 . This result was statistically significant in determining the gender from the breadth of face (p value, 0.001). Mean facial index calculated from the length and breadth of face of 100 males of the study population was 95.14 ± 5.54 . In the 100 females, the mean facial index was 99.57 ± 6.42 . This result was statistically significant in differentiating gender (p value, 0.001). Based on the facial index estimated from the length and breadth of face, the face was grouped into five types such as Hypereuryropy, Euryprosopy, Mesoprosopy, Leptoprosopy and Hyperleptoprosopy (Table 3)

Table 3. Facial index and type of face frequency in the study population

Facial Index	Type of bead	Frequency			Percentage
		Male No.	Female No.	Total NO.	
≤79.9	Hypercuryproopic	0	1	1	5
80 to 84	Euryprosopic	3	0	3	1.5
85 to 89.9	Mesoprosopic	17	9	26	13.0
90 to 94.9	Leptoprosopic	27	11	38	19.0
≥95	Hyperleptoprosopic	53	79	132	66.0
Total		100	100	200	100.0

DISCUSSION

In the present study of 200 subjects, cephalometric measurements of the head, nose and face were taken. From the mean length and breadth of head, cephalic index was calculated. Based on the cephalic index, 89 subjects (44.5%), were categorised as dolichocephalic and 68 subjects were mesocephalic (34%). There was not much difference in the male-female ratio also. When the mean cephalic indices were analysed statistically there was no significant gender discrimination (p value, 0.100). But when the mean length and breadth of head in the study subjects were analysed statistically it was found to be statistically significant in differentiating gender. In a study conducted by Mahesh kumar *et al.* 12 (2013) in 600 subjects from Haryanvi Banya caste of Haryana it was revealed that 463 were dolichocephalic (77%). Mesocephalic type of head ranks next (17%). Twisha shah *et al.* 13 (2015) had determined the cephalic index of 901 Gujarathis and 300 non Gujarathis of Ahemadabad. Among the Gujarathis 40.5 % subjects were dolichocephalic and 40.7 were mesocephalic. Among non Gujarathi population 62.3 % of the subjects were dolichocephalic. Mesocephalic was 18%. This result is more or less similar to the present study. Sunita Patro 14 (2014), had conducted a similar study among 1030 subjects aged above 18 years of south Odisha and it was found that 58.7% subjects were mesocephalic. Of the subjects 19.5% were dolichocephalic. This shows that there is a difference in the type of head of Kerala population and Oriyas. In a similar study conducted by Priti Nemade 5 (2014) among 320 Maharashtrians in the age group of 20-30 years, 44% were mesocephalic. Dolichocephalic type of head was seen only in 19% of the subject. This shows that there is difference in the type of head of Maharashtrians and Kerala Population. In the present study, measurements of the height and width of nose were taken and nasal index of the study population was determined. Based on the nasal index shape of the nose of study subjects was categorised into three types such as Leptorrhine, Mesorrhine and Platyrrhine. Of the study population 55.5 percent had Mesorrhine type of nose. Leptorrhine type of nose was seen in 35% of the study subjects. In the study group, males were predominantly Mesorrhine (69%) and females were Leptorrhine (51%). The present study also revealed that the mean nasal indices of males and females are statistically significant in gender differentiation. The mean breadth of nose was also statistically significant in determining sex. But mean length had no significance. Girish Patel *et al.* 15 (2014) had

conducted a study among 250 subjects of south Indian population in the age group of 18-30 years. Majority of the males of this group were having a mesorrhine type of nose, while the females were having a leptorrhine type of nose. This result is similar to that of the present study. Moreover the results were statistically significant also. Sharma S.K *et al.* 16 (2014) in a study conducted among 204 subjects of Hindu community of Gwalior in the age group of 19-45 years found out that 63.7% of the subjects were having a mesorrhine type of nose. Platyrrhine type of nose was found in 21.57% of the subjects. The first majority of the present study is similar to the Gwalior group. But second majority is different. Platyrrhine type of nose was seen only in 9.5% of the present study group. In the present study measurements of the length and breadth of the face were taken and facial index was calculated. Based on this, the type of face were classified into five types(Table 3). Of the study group 66% were having hyperleptoprosopic type of face. Leptoprosopic type of face was seen in 19% of the total subjects. The mean facial index, mean facial length and breadth are found to be statistically significant in differentiating gender. Shetty R V *et al.* 6 (2011) had studied the facial measurements of 300 medical students of Manipal in the age group of 18-22 years. Of the 300 students 200 were from Malaysia. 29% of the the Malaysian population were having Mesoprosopic face. Of these subjects, 27% were Leptooprosopic. Among the Non Malaysians, 31% were having a Mesoprosopic type of face. 30% were Euryprosopic. This finding is dissimilar to the observations of the present study. Maheshkumar *et al.* 17 (2013) had studied the types of face in 600 Haryanvi Banyas. 42% of the study subjects were having a mesoprosopic type of face. 21.6% of the group was Euryprosopic. The results are dissimilar to the present study.

CONCLUSION

In the present study conducted among 200 adults between the age group of 20-50 years hailing from different districts of Kerala, craniofacial measurements such as the lengths (height) and breadths of head, nose and face were taken to estimate the cephalic, nasal and facial indices. The cephalic index determines the shape of head. Nasal and facial indices determine the type of nose and face. Some of the measurements were found to be statistically significant in differentiating the gender also. The present study arrived at the following conclusions: -

1. The mean length and breadth of the head are statistically significant in differentiating the gender.
2. Cephalic index calculated from the length and breadth of head and based on it the shape of head was categorised into four types viz dolichocephalic, mesocephalic, brachycephalic and hyperbrachycephalic.
3. The majority of the present study group (44%) were having a dolichocephalic type of head; mesocephalic ranking next (34%).
4. Cephalic index was not statistically significant in differentiating gender.
5. Based on the nasal index, nose was categorised into 3 types viz Mesorrhine, Leptorrhine and Platyrrhine
6. Majority of the study population had a Mesorrhine type of nose (55.5%). The next in rank is Leptorrhine (35%)
7. Mean breadth of nose and mean nasal index are statistically significant in determining the gender. But mean height of nose has no statistical significance.
8. Based on the mean facial index the study population was categorised into five types such as Hypereuryropy, Euryprosopy, Mesoprosopy, Leptoprosopy and Hyperleptoprosopy.
9. Majority of the study group (66%) were having a hyperleptoprosopic type of face. Leptoprosopic type of face was seen in 19% of the total subjects.
10. Mean length and breadth of face and mean facial index are statistically significant in differentiating gender (Table 4)

Table 4. Mean cranio-facial indices in the study population

Craniofacial Indices	Mean (Males)	Mean (Female)
Cephalic Index	76.64±4.45	75.56±4.73
Nasal Index	76.02±7.32	71.01±8.24
Facial Index	95.14±5.54	99.57±6.42

Scope and Limitations

The result of this study will be highly useful in forensic anthropology in the identification of unknown, unidentified dead bodies and skeletal remains. The study group of 200 subjects can be considered as a cross section of the Kerala population as they hail from all the districts of Kerala. But to have objectivity, validity and reliability

of the research, the study, has to be conducted among a larger group randomly selected from each district of Kerala

REFERENCES

1. Krogman WM, Iscan MY. Human Skeleton in Forensic Medicine. Springfield Illinois: Charles C Thomas : 1986 p. 302-351.
2. Umadethan B. Principles and Practice of Forensic medicine. Swamy Law Publisher 2008. p.93 – 124.
3. Rabey GP. Craniofacial morphoanalysis. Proc. R. Soc. Med. 1971; 64:103- 111.
4. Shah GV, Jadhav HR. The study of cephalic index in students of Gujarat. J Anat Soc India 2004;53(1)25-26.
5. Priti AN, Amit SN. Study of cephalic index in Maharashtra. Int J Biol Med Res 2014;5(3):4258-4260.
6. Shetty RV, Pai SR, Sneha GK, Gupta C, Chethan P, Soumya. Study of Prosopic index of Indian and Malaysian students. Int J Morphol 2011;29(3):1018-1021.
7. Sharma SK, Massarat J, Rajlekshmi S, Subir S, Akhilesh T, Vipendra B *et al.*. Anthropometric comparison of nasal parameters between male and female of Gwalior region. IOSR-JDMS 2014; 13(5):57-62.
8. William P, Dyson M, Dussaak J E, Bannister LH, Berry MM, Collins P, Ferguson MWJ. Gray's Anatomy. In: Skeletal system, 38th Edn. Elbs with Churchill Livingstone, London, p 607-612(1995).
9. Martin, R., and K. Saller . Lehrbuch der anthropologie. Gustav Fischer Verlag, Stuttgart,1957.
10. Risely, H.H., 1915. The People of India. 2nd Edn., Crooke W.(Ed.), 1969, pp:395-399.
11. Singh I P, Bhasin MK. Anthropometry. Delhi, kamala Raj Enterprises,1989.
12. Mahesh Kumar, Patnaik V V Gopichand. The study of cephalic index in Haryanvi population. Int J Pure App Biosci 2013; 1(3).
13. Twisha S, Manish BT, Shobhana KM. Assessment of cephalic and facial indices: A proof for ethnic and sexual dimorphism. J Forensic Sci Criminol 2015; 3(1):1-11.
14. Sunita Patro, Ramkristna Sahu, Sadananda Rath. Study of cephalic index of southern Odisha population. IOSRJDMS 2014;13(1):41-44.
15. Girish VP, Shishir Kumar, Apoorva D, Thejaswari, Javed S, Sheshagiri C *et al.*. Study on nasal index in South Indian population. International Journal of Current Research 2014;6(8):8163-8164.
16. Sharma SK, Massarat J, Rajlekshmi S, Subir S, Akhilesh T, Vipendra B *et al.*. Anthropometric comparison of nasal parameters between male and female of Gwalior region. IOSR-JDMS 2014; 13(5):57-62.
17. Mahesh Kumar, Mohd. Muzzafar Lone. The study of facial index among Haryanvi adults. IJSR 2013; 2(9):51-53.

Source of Support: None Declared
Conflict of Interest: None Declared

Policy for Articles with Open Access:

Authors who publish with MedPulse International Journal of Forensic Medicine (Print ISSN: 2579-0935) (Online ISSN: 2636-4735) agree to the following terms: Authors retain copyright and grant the journal right of first publication with the work simultaneously licensed under a Creative Commons Attribution License that allows others to share the work with an acknowledgement of the work's authorship and initial publication in this journal.

Authors are permitted and encouraged to post links to their work online (e.g., in institutional repositories or on their website) prior to and during the submission process, as it can lead to productive exchanges, as well as earlier and greater citation of published work.