

## ORIGINAL ARTICLE

**Sex Determination by Morphometry of Lips***B. Senthil Kumar<sup>1\*</sup>, G. Panneer Selvi<sup>2</sup>*

<sup>1</sup>Department of Anatomy, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem-636308 (Tamil Nadu) India, <sup>2</sup>Penang International Dental College, Salem-636308 (Tamil Nadu) India

**Abstract**

**Background:** Facial anthropometric parameters are affected by various factors including age, sex, ethnicity, socioeconomic status, environment and region. The lips become thinner as age increases and the wet line moves caudally, in addition oral commissure begins to downturn. **Aim and Objectives:** The purpose of this study was to create a baseline data in determining the sex of the people from India and Malaysia depending on morphometry of lips. **Materials and Methods:** A total of 100 Malaysians and 100 South Indians were enrolled for the study. Various morphometric measurements of lips were taken using Vernier caliper. The data were analyzed by one way ANOVA to find out the significance among the sex and population. **Results:** All the measurements of upper and lower lips were higher in males as compared to females and thus sexual dimorphism exists. Mouth width and height were found to be more in Indian males followed by Malaysian males whereas in females it's vice versa. Vermilion upper lip occupied less than half of total upper lip height, whereas vermilion lower lip occupied more than half of total lower lip height in both the population. Indian males and females differed significantly in lip parameters from those of Malaysian males and females. **Conclusion:** It can be concluded from the study that same standards cannot be used on each other's populations for identification and cosmetic surgery. The study highlights the applied significance of observations to forensic medicine namely, personal identification, racial and sex dimorphic criteria of identification.

**Keywords:** Morphometry, Sex determination, Indian, Malaysian, Lips

**Introduction:**

Anatomy and dimensions of facial structures are considered as useful criteria for surgeons undertaking repair and reconstruction of facial deformities to maintain optimal relationships among facial structures [1, 2]. The knowledge of relationships among facial structures will help in correct diagnosis and treatment of individuals with various facial anomalies such as cleft lip, oblique facial cleft and disproportionate facial structures which occurs congenitally [3].

The physical appearance of an individual is associated to various factors such as social-psychological well-being, and the self-esteem of an individual which is strongly dependent on facial appearance. An attractive pleasing face depends on many factors such as culture, personality, ethnic background and age [4]. Aging and sex particularly affects the lips, with changes in thickness, and in vermilion dimensions, coupled with the distance between the nose and the upper lip vermilion border, and in mouth width [5,6]. As the morphological changes of lips, it is applicable in forensics and discrimination between races. Obtaining measurements of the soft tissues of the face is important in terms of achieving aesthetic criteria [7]. Aesthetic results from clinical treatments thus depend on the anatomic structures

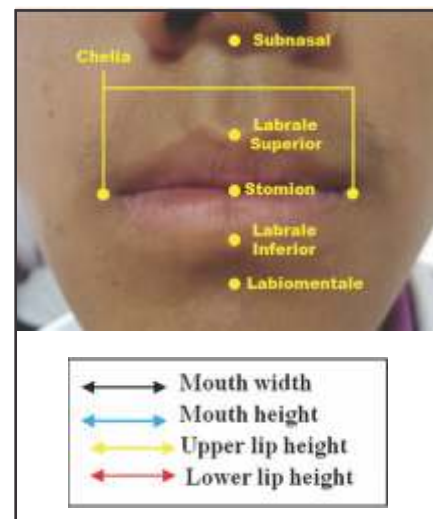
present. When anthropometric methods were used into clinical practice to quantify changes in the craniofacial structures, features distinguishing various races/ethnic groups were discovered [8]. A number of studies have investigated facial profiles by measuring the angles and separation of the soft tissues using cephalographs, two-dimensional photogrammetry or direct measurements [9-11].

The study was aimed to create a baseline data in determining the sex of the people from India and Malaysia depending on morphometry of the lips. To measure the width and height of the mouth, medial vermilion height of upper and lower lips and height of upper and lower lips of an individual and to compare it between the two groups of population, South Indians and Malaysians.

#### Material and Methods:

This cross-sectional study was approved by Institutional Ethics Committee; reference (VMKVMC/IEC/18/02). A total of 100 Malaysians (50 males and 50 females) and 100 South Indians (50 males and 50 females) of age group ranging between 20 to 40 years were enrolled for the study and an informed consent was taken from each one of them. This cross sectional study was carried out in Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem. In each population sampling was done by random sampling methods. Volunteers with any facial anomalies were excluded from the study. Various morphometric measurements of lips such as mouth width - is the distance between two chelia, mouth height - is the distance between labrale superior to labrale inferior, medial vermilion height of upper lip - is the distance between labrale superior to stomion, medial vermilion height of lower lip - is the distance between labrale inferior to stomion,

upper lip height - is the distance between subnasale to stomion and lower lip height - is the distance between stomion to labiomentale (Fig. 1) were measured using digital caliper [12]. The data were tabulated and analyzed by one way ANOVA to find out the significance among the population and Post HOC pairwise comparison for comparison among the groups.



**Fig. 1: Various Anatomical Landmarks for Morphometry of Lips**

#### Results:

The morphometric data was collected and analyzed by one way ANOVA to find out the significance among the population and Post HOC pairwise comparison to compare between the sexes. The mouth width and height were found to be more in Indian males followed by Malaysian males whereas; in females it was vice a versa. When compared among the population the mouth width and height were found to be highly statistically significant (Table 1).

**Table 1: Mouth Width and Mouth Height of Both Populations**

Population	Sex	Mouth Width (mm)	Mouth Height (mm)
Malaysian	Male	49.0±0.42	19.1±0.35
	Female	48.6±0.35	18.8±0.42
Indian	Male	50.1±0.42	20.1±0.28
	Female	47.8±0.36	17.9±0.42
<b>P value</b>		0.001***	0.001***

Values are expressed as Mean ± SD, n = 100 in each population with 50 males and 50 females, # - non significant, \* - significant, P value \*P<0.05, \*\*P< 0.01, \*\*\*P<0.001

**Table 2: Upper and Lower Lip Height of Both Populations**

Population	Sex	Medial vermilion height of upper lip (mm)	Medial vermilion height of lower lip (mm)	Upper lip height (mm)	Lower lip height (mm)
Malaysian	Male	9.0±0.21	11.1±0.28	25.0±0.49	20.9±0.21
	Female	8.3±0.21	10.7±0.28	21.1±0.28	19.2±0.35
Indian	Male	9.5±0.21	11.4±0.21	19.2±0.28	16.3±0.42
	Female	8.5±0.21	9.8±0.21	17.8±0.28	14.9±0.28
<b>P value</b>		0.001***	0.001***	0.001***	0.001***

Values are expressed as Mean ± SD, n = 100 in each population with 50 males and 50 females, # - non significant, \* - significant, P value \*P<0.05, \*\*P< 0.01, \*\*\*P<0.001

**Table 3: Post HOC Pairwise Comparison of Morphometry of Lips among Malaysian and Indian Populations**

Comparison	Mouth width	Mouth height	Medial vermilion height of upper lip	Medial vermilion height of lower lip	Upper lip height	Lower lip height
Malaysian M vs Malaysian F	S	S	S	S	S	S
Malaysian M vs Indian M	S	S	S	S	S	S
Malaysian M vs Indian F	S	S	S	S	S	S
Malaysian F vs Indian M	S	S	S	S	S	S
Malaysian F vs Indian F	S	S	S	S	S	S
Indian M vs Indian F	S	S	S	S	S	S

M – Male, F – Female, vs – versus, n = 100 in each population with 50 males and 50 females, NS - non significant, S - significant

The vermilion height of upper lip occupies half of the total upper lip height and both were statistically significant when compared among the sexes and population. Similarly the vermilion height of lower lip was more than half of the total

lower lip height and both heights differed significantly among both sexes and population (Table 2). Upper and lower lip height when compared was found to be significant among the population. The measurements were compared in

**Table 4: Mean Lip Parameters among Male Population of Previous Studies and the Present Study**

Authors	Region of study population and number of subjects	Vermillion height of upper lip	Upper lip height	Vermillion height of lower lip	Lower lip height	Mouth height	Mouth width
Farkas <i>et al.</i> (1984) [15]	North white American (n=50)	7.4±1.7	22.7±2.3	8.8±2.0	18.8±2.5	-	54.1±3.8
Khanderkar <i>et al.</i> (2005) [16]	Western Indian (n=100)	-	-	-	-	-	53.5±1.0
Ngeow <i>et al.</i> (2009) [17]	Malay (n=50)	9.8±1.1	22.7±2.0	12.0±1.6	-	-	48.8±3.5
Ngeow <i>et al.</i> (2009) [18]	Malaysian Indian (n=50)	9.2±1.3	21.6±2.0	11.5±1.6	-	-	47.3±3.3
Milosevic <i>et al.</i> (2010) [19]	Caucasian (n=52)	8.3±1.3	23.5±2.64	8.67±1.6	18.92±2.29	-	-
Heidari <i>et al.</i> (2014) [1]	Sistani (n=50)	-	18.9±0.11	-	-	27.2± 0.02	49.0±0.21
Heidari <i>et al.</i> (2014) [1]	Baluch (n=50)	-	18.9±0.14	-	-	15.3± 1.70	47.7± 0.27
Goel <i>et al.</i> (2015) [20]	North Indian (n=300)	8.85±1.5	20.51±2.2	9.70±1.6	16.00±2.2	-	47.17±3.4
Present study (2017)	South Indian (n=50)	9.5±0.21	19.2±0.28	11.4±0.21	16.3±0.42	20.1±0.28	50.1±0.42
Present study (2017)	Malaysians (n=50)	9.0±0.2	25.0±0.49	11.1±0.28	20.9±0.21	19.1±0.35	49.0±0.42

Values are expressed as Mean ± SD (mm), n – sample size

between sexes of each population by Post HOC pairwise comparison and all the measurements were found to be statistically significant (Table 3).

#### Discussion:

Girls have larger lips, with an increased vertical dimension and also larger mouth width [13]. Esthetic reference values can be used to determine optimal timing and goals in orthodontic treatment

[13]. In case of lower lip, less than half of total lower lip height was occupied by cutaneous portion of lower lip and rest was covered by vermilion portion of lower lip [14]. The present study highlights the applied significance of observations to forensic namely personal identification, racial and sex dimorphic criteria of identification.

**Table 5: Mean Lip Parameters among Female Population of Previous Studies and the Present Study**

Name of authors	Region of study population and number of subjects	Vermillion height of upper lip	Upper lip height	Vermillion height of lower lip	Lower lip height	Mouth height	Mouth width
Farkas <i>et al.</i> (1984) [15]	North white American (n=50)	7.7±1.1	19.6±2.1	9.0±1.5	16.7±2.0	-	50.6±3.1
Khanderkar <i>et al.</i> (2005) [16]	Western Indian (n=100)	-	-	-	-	-	47.0±0.7
Ngeow <i>et al.</i> (2009) [17]	Malay (n=50)	9.1±1.0	18.2±2.9	11.0±1.2	-	-	47.1±3.5
Ngeow <i>et al.</i> (2009) [18]	Malaysian Indian (n=50)	8.6±0.9	19.4±1.7	10.9±1.0	-	-	45.9±3.0
Milosevic <i>et al.</i> (2010) [19]	Caucasian (n=52)	8.52±1.35	20.57±2.01	8.60±1.35	17.67±1.73	-	-
Goel <i>et al.</i> (2015) [20]	North Indian (n=300)	8.06±1.1	18.72±2.0	9.15±1.3	14.57±1.8	-	44.27±3.2
Present study (2017)	South Indian (n=100)	8.5±0.21	17.8±0.28	9.8±0.21	14.9±0.28	17.9±0.42	47.8±0.36
Present study (2017)	Malaysians (n=100)	8.3±0.2	21.1±0.28	10.7±0.28	19.2±0.35	18.8±0.4	48.6±0.35

Values are expressed as Mean ± SD (mm), n – sample size

The mouth width and height were found to be more in Indian males followed by Malaysian males whereas in females it's vice versa in both the population (Table 1). Cutaneous upper lip occupied more than half of entire upper lip height while vermilion upper lip occupied less than half of upper lip height. Cutaneous lower lip occupied less than half of entire lower lip height while vermilion lower lip occupied more than half of lower lip height in Malaysian population (Table 2). Cutaneous upper lip occupied more than half of entire upper lip height while vermilion upper lip occupied less than half of upper lip height. Cutaneous lower lip occupied less than half of entire lower lip height while vermilion lower lip occupied more than half of lower lip height in Indian population (Table 2). Indian males and females differed significantly in lip parameters from those of Malaysian males and females. All the measurements of upper and lower lips were higher in males as compared to females and thus sexual dimorphism exists.

The morphometry of lips was compared among different population from earlier studies (Table 3 and 4). The mouth height in the present study showed a difference of 2 to 3 mm among Indian male and female whereas in Malaysian male and female the mouth height was almost within the same range. The mouth width of Indian male vs female was in correlation with the study done by Khanderkar *et al.* in western Indian [16]. The mouth width of Malaysian male and female was within the same range with the study done by Ngeow *et al.* in Malaysian Indian and Malay population [17].

The upper and lower lip height of Indian males was found to be more than Indian females which was in correlation with the study done by-Goel *et al.* [20]. The heights of both lips were found to be different in Malaysian males and females, and the measurement was found to be more when compared with the study done in Malaysian population by Ngeow *et al.*, (Table 4 and 5) [18]. The vermilion height of upper and lower lips was found to be more in males when compared to that of females in both the population whereas the measurement of vermilion upper and lower lip of the present study is in correlation with the study done by Goel *et al.* [20] in North Indians and Ngeow *et al.* [17] in Malaysian population (Table 4 and 5).

#### **Conclusion:**

All the measurement of upper and lower lip parameters were higher in males as compared to females and thus sexual dimorphism exists. Indian males and females differ significantly in lip parameters from that of Malaysians males and females. The study concludes that the same standards cannot be used on each other populations for identification and cosmetic surgery. The study has given a base line data for determining the sex among Indian and Malaysian population. The morphometric data can be used for surgical or orthodontic treatments.

## References

1. Zahra H, Hamidreza MS, Azam AR, Narjes D. Anthropometric Measurements of the Lips in 18-25-year-old Men of Sistani and Baluch Descent. *Bull Env Pharmacol Life Sci* 2014; 3(12): 139-42.
2. Uzun A, Akbas H, Bilgic S, Emirzeoglu M, Bostanci O, Sahin B, *et al.* The average values of the nasal anthropometric measurements in 108 young Turkish males. *Auris Nasus Larynx* 2006; 33(1): 31-5.
3. Peck S and Peck L. Selected aspects of the art and science of facial esthetics. *Semin Orthod* 1995; 1(2): 105-26.
4. Fernández-Riveiro P, Smyth-Chamosa E, Suárez-Quintanilla D, Suárez-Cunqueiro M. Angular photogrammetric analysis of the soft tissue facial profile. *Eur J Orthod* 2003; 25(4): 393-9.
5. Sforza C, Grandi G, Binelli M, Dolci C, De Menezes M, Ferrario VF. Age- and sex-related changes in three-dimensional lip morphology. *Forensic Sci Int* 2010; 200(1-3):182.e1-7.
6. Demenes M, Rosati R and Baga I. Three-dimensional analysis of labial morphology: effect of sex and age. *Int J Oral Max Surg* 2011; 40(8): 856-61.
7. Ozdemir MB, Ilgaz A, Dilek A, Ayten H, Esat A. Describing normal variations of head and face by using standard measurement and craniofacial variability index (CVI) in seven-year-old normal children. *J Craniofac Surg* 2007; 18(3): 470-74.
8. Farkas LG, Katic MJ, Forrest CR, Alt KW, Bagic I, Baltadjiev G, *et al.* International anthropometric study of facial morphology in various ethnic groups/races. *J Craniofac Surg* 2005; 16(4): 615-6.
9. Taskinalp O, Erdem N. Some vertical proportions of the face in turkish adults. *Balkan Medical Journal* 2009; 26(1): 49-52.
10. Porter JP, Olson KL. Anthropometric facial analysis of the African American woman. *Arch Facial Plast Surg* 2001; 3(3): 191-7.
11. Emirzeo lu M, ahin B, Uzun A, Bilgiç S. Evaluation of the volumetric relation between cranial cavity and orbits. *Turkiye Klinikleri J Med Sci* 2011; 31(2): 297-9.
12. Indera P Singh, Bhasin MK. A manual of biological anthropology. 2<sup>nd</sup> Ed. Delhi: Kamla Raj enterprises; 1995:232-57.
13. Sforza C, Laino A, D'Alessio R, Dellavia C, Grandi G, Ferrario VF. Three-dimensional facial morphometry of attractive children and normal children in the deciduous and early mixed dentition. *Angle Orthod* 2007; 77 (6):1025-33.
14. Goel A, Mahmood S, Patnaik VVG. Study of lower lip proportions in North Indian adults. *Int J Med Dent Sci* 2014; 3(1):264-9.
15. Farkas LG, Katic MJ, Hreczko TA, Deutsch C, Munro IR. Anthropometric proportion in the upper lip-lower lip-chin area of lower face in young white adults. *Am J Orthod* 1984; 82(1): 52–60.
16. Khandekar B, Srinivasan S, Mokal N, Thatte MR. Anthropometric analysis of lip- nose complex in Indian population. *Indian J Plast Surg* 2005; 38(2):128-31.
17. Ngeow WC, Aljunid ST. Craniofacial anthropometric norms of Malays. *Singapore Med J* 2009; 50(5): 525–528.
18. Ngeow WC, Aljunid ST. Craniofacial anthropometric norms of Malaysian Indians. *Indian J Dent Res* 2009; 20(3): 313-9.
19. Anic-Milosevic S1, Mestrovic S, Prli A, Slaj M. Proportions in the upper lip-lower lip-chin area of the lower face as determined by photogrammetric method. *J Craniomaxillofac Surg* 2010; 38(2): 90-5.
20. Goel A, Patnaik VVG, Puri N. Lip morphometry in 600 North Indian adults: a data base study for sexual dimorphism. *Med Sci Law* 2015; 55(1): 16-21.

\*Author for Correspondence: Dr. B. Senthil Kumar, Department of Anatomy, VMKV Medical College & Hospital, Salem, Tamilnadu – 636308 Email: skdrchinu88@gmail.com Cell - 09894398677