Omniscient
(An International Multidisciplinary Peer Reviewed Journal)
Vol 3 Issue 3 July-Sept 2025 EISSN: 2583-7575

Horizontal Proportions of the Face Biometric among Brahmins and Vaishyas Male and Female in Lucknow District

Preeti Gupta

Department of Anthropology, Sri Jai Narayan Mishra P.G. College, Charbagh, Lucknow
Corresponding author: preet.30jan@rediffmail.com
Available at https://omniscientmjprujournal.com

Abstract

Biometrics refers to a particular class of identification technologies which use an individual's unique biological traits to determine one's identity. Faces have long been used as a means of human identification in the forensic field. Its reliability increases when we concentrate on specific population due to uniqueness of its gene pool. This article is based on the comparative analysis of face biometrics of Brahmin and Vaishya communities of Lucknow District. Objectives: The objectives of the present study will be as follows-To apply the fundamental principles of face biometric for personal identification of Brahmins and Vaishyas population inhabiting in Lucknow district. To access the face recognition among both endogamous the population inhabiting in Lucknow district. To identify the varying frequencies of biometrics trait in different caste to be considered and gender differences in relation to quantitative biometrics traits. To find out the intrapopulation and interpopulation variation among Brahmins and Vaishyas community-based face biometric. Methods: The data for the study was obtained from 400 males and females subjects (200 Brahmins males and 200 Vaishyas). Five measurements were taken using five selected landmarks and 7 indices were calculated from the frontal face images of each individual. Results: A t-test revealed, significant ethnic differences ($p<0.05$) between Brahmin and Vaishya males and females The purpose was to examine the existence of Horizontal proportions of the Face Biometrics among Brahmins and Vaishyas male and female Lucknow population. The result indicates that this method is useful in recognizing faces. Conclusion: face of a person holds utmost importance and it should be studied first of all because the human face is the reflection of individual uniqueness of a person.

Keywords: Face Recognition, Biometrics, Brahmins, Vaishyas, Males, Females

Introduction

The term Biometrics has its origin from the Greek words bios (life) and metric (measure). This means life and measurement respectively. Biometrics is the most powerful technology sector that

refers to an individual class of identification technology. These technologies used in individual's unique biological traits to establish one's identity. Biometrics is person's identification based on his/her physiological or behavioural characteristics. Most of the system needs personal reliable recognition system to prove or determine the identity of an individual who requires particular service. (Sumathi and Malini et al., 2011).

Face Biometrics: The main aim of biometry is to make systems that can identify people from some recognizable characteristics such as their face, fingerprints, iris, etc. Identification of humans by the unique characteristics of their face is called facial recognition. With the globalization of the world, the requirement of identification of individual has increased and has become a necessity of the current age. In recent society the person identification systems are progressively becoming prevalent. Modern face recognition has achieved an identification rate of higher than 90% for larger databases with well-controlled lighting and pose situations. (Fromherz and Bichsel et al. 1997). The face recognition is enhanced biometrics compared to other biometric characteristics as the image can be captured without the knowledge and support of a person. (Hiremani and Hatture, 2013).

A new approach introduced in year 2012 in which the facial features from training images are extracted, then ratios of length, width, and area are calculated and stored as features for individual images, these uniqueness of face eventually helps us to identify a person and differentiate from another face. Face has its individual form, dimensions and features which can be evaluated morphologically as well as metrically. (Roelofse and Becker et al. 2008).

Biometric facial recognition system will quickly overtake fingerprint biometrics as the most famous appearance authentication. While the advent of photography, both government agencies and private organizations have reserved face photo sets of people (e.g. passports, personal identification documents, membership cards, etc.).

Face Recognition Methods: In the beginning of the 1970's, face recognition was treated as 2D pattern recognition. (Goldstein, et al., 1971). The distances between main points where used to recognize known faces, e.g. measuring the space between the eyes or other important points or measuring various angles of facial components. A number of algorithms have been proposed for face recognition. Such algorithms can be divided into two categories:

- Appearance Based
- Feature Based

1. Appearance-based Method: This method uses the whole face area as the input to the face recognition system. These systems usually operate on 2D images, using the raw image data to make comparisons of other face images. Its method has received significant attention from a wide range of research areas such as biometrics, pattern recognition. Specifically, there are two categorizations implied viz. Holistic and Hybrid approaches. (Nefian and. Hayes et al.,1998).

2. Feature Based Method: The facial features of human being have played a significant task in the recognition of persons for long time. After performing anthropometric measurement on several frontal face images taken from various human‘s subjects, an anthropometric model of the human face is build that can be used to locate the most important facial feature areas from face images. (Sohail and Bhattacharya et al.,2006). Features in facial images include eyes, nose, mouth, lips and chin etc., of human have played a significant role in the recognition of individuals, which are selected from face images, and then compute the geometric relationships properties among those facial points, thus tumbling the input facial image to a vector of geometric features and relations such as areas, distances between the features are selected as the descriptors of faces for recognition. (Ivancevic et al., 2003). Standard statistical pattern recognition techniques are then employed to match faces using these measurements. The main advantage obtained by the featured-based techniques is that since the extraction of the feature points precedes the analysis done for matching the image to that of an identified individual, such techniques are relatively strong to location variations in the input image. It is appreciably different from the feature-based systems that it constructs the topological graph using the facial features of every subject. (Beham and Roomi et al., 2013).

Photo-anthropometry: Various studies have showed that the personal identification process can also be done by using anatomical landmarks and measurements or proportions obtained using landmarks from the photograph evidence. This technique traces its roots to traditional anthropometric methods. In face anthropometry, the quantification measurements are taken from photographs; it is called photo-anthropometry. This form of identification can be termed as ‘Facial Image Identification’ or ‘Photoanthropometry’. Photogrammetry is based on the spatial measurements of facial features as well as distance between facial landmarks. (Alspaugh et al.,2004). Photo-anthropometry is now an acceptable tool in the identification with a manual technique. In the present research to overall the manual method for identification.

Materials and Methods

Present study the procedure of purposive sampling was adopted. In this research deals with the measurement on face of 400 subjects including 200 Brahmins and 200 Vaishyas (100 male and 100 female) belonging two endogamous caste groups, i.e. Brahmins and Vaishyas of Lucknow region the age groups of 18-45 years.

From the general information of all the subjects obtained before taking the photographs with name, age, sex, community, caste, sub caste, domicile and address, were recorded (by cross-checking information mentioned by them as per their Identity card or Aaddhar card). Data for the present study were selected from the various places viz. colleges and University for the younger age groups in different areas of Lucknow Region. For the representative population following areas were covered, which are listed below:

Alambagh, Alamnagar, Aishbagh, Aliganj, Aminadad, Ashiyana, Bawali, Charbagh, Chowk, Daliganj, Ganeshganj, Gomtinagar, Indranagar, Janakipuram, Rajajipuram, Saadatganj, Thakurganj, Telibagh. The following equipment are essential while dealing with face biometrics:

Camera:

A camera is an optical instrument used to capture images, which are stored in a physical medium such as in a digital system or on photographs. It is a very essential tool for this study. Sony Lens G cyber shot 20x optical zoom digital camera was used in order to get a very clear facial image.

Tripod:

It is an essential equipment to provide stability while taking the photographs. Frontal face of 200 individuals was photographed using "Sony Lens G cyber shot" under the similar lighting conditions, with no illumination changes. Setting of the camera was same throughout the collection of photographs. The camera was setup on a tripod at same height of (105cm). The photographs of frontal face of all the subjects were taken from the angles perpendicular to the head with a fixed distance of 2 feet between face and the camera. Structure of Face Biometric system has four main features that are: Photography, Image Preprocessing, Normalization and Face Photometric Measurements (Brunelli and Poggio et al., 1993)

Photography:

Each subject chosen for the study was made to sit comfortably on the stool with back straight and head positioned in eye-ear plane (It is the standard position of the head when two orbitale and 2 porion are in the same plane). The height of the tripod was adjusted so that it was equal with the

height of the subject's face and entire face was visible within the shot. The timer of the camera was used so as to avoid movement in taking the shot. The photographs were taken from a distance of 2 feet (Aksu and Kocadereli et al. 2010) with a Sony Lens G cyber shot 20x optical zoom digital camera in order to get a very clear facial image. The setting of the camera the White balance was set at Fine, Continuous at Single, Image adjustment at Normal, Lens at Normal, Focus at AF area mode (Auto), Aperture at10.3, Shutter speed at 0.25 sec., Zoom at Maximum optical. The photographs were saved in JPEG format and uploaded directly to the software (Adobe Photoshop CS3), with 300 dpi resolution.

2. Image Preprocessing:

The photographic records were transferred to the computer with the help of Adobe Photoshop CS3 software was used in image preprocessing; every image has gone through the following steps:

- Face image was cropped manually from the side face image of a person.
- Cropped face image was resized.
- Colored image was converted to gray scale image.

The sizes of cropped face images were different. In order to find same number of features from each frontal face image, resizing the images to unique fixed size of 5x7 inches (1500 x 2100 pixel) were made. Fig**.** 2-5 demonstrates the output at the end of preprocessing step. Figure.2 (a) shows the original image in the database, figure.3 (b) cropped image, figure.4 (c) resized image and figure.5 (d) gray scale image.

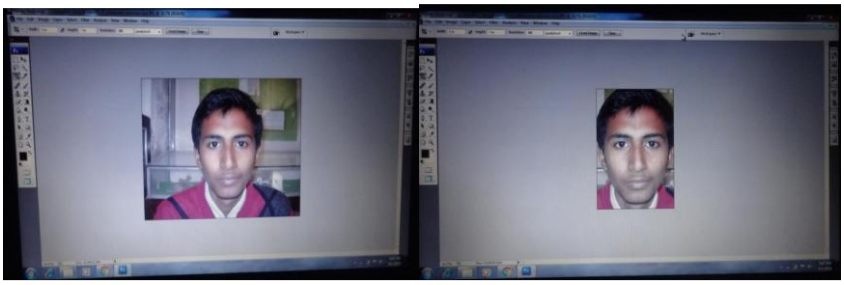

Fig.2: Original image (a) Fig.3: Corp image (b)

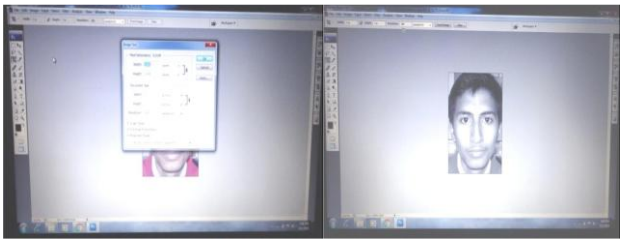

Fig.4: Resized image (c) Fig.5: Gray scale image (d)

3. Normalization:

The face needs to be normalized. To normalize an image, the key facial landmarks must be located accurately i.e., the image must be standardized in terms of size, pose, illumination etc. Light does not impact the normalization process. (Ramchandra and Kumar et al., 2013). The photograph of the frontal face was placed on a development easel and landmarks aligned such as zygion, ectocanthion, endocanthion, cheilion, and alare, was then detected and used as the origin. These landmarks are used to normalize the image and to initialize the method that localizes the facial components (eyes, cheeks, and mouth,) and precisely extracts 5 horizontal facial landmarks, from the frontal images of a face, which was shown in Figure 6. These measurements have been used to distinguish individuals.

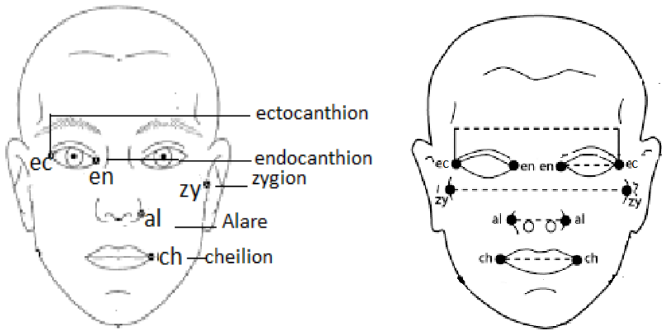

Fig. 6: The location of some of the anatomical landmarks used in facial photometric and The 5 horizontal facial landmarks of frontal face

Face photometric measurements:

The facial pictures were carefully scaled using the distances between landmarks in the horizontal plane. These were then equally carefully aligned and lines drawn through as many landmarks as possible. The measurements were taken on the photographs with the sliding caliper and then the possible proportions were worked out from these measurements taken on photograph. 5 measurements between 5 selected landmarks were selected manually and 7 indices were taken and calculated for each subject's photographs from the frontal images.

Definition of anatomical landmarks used in present study

Measurements	Landmarks	Definitions
Bizygomatic breadth	zy-zy	**Zygion(zy) :-** The most laterally projecting point on the zygomatic arch. The point is determined by measuring the maximum bizygomatic breadth.

Interoccular breadth	en-en	**Endocanthion:-** Inner corner of the palpebral opening, medial to the caruncula lacrimalis.
Binocular breadth	ec-ec	**Ectocanthion:-** Outer corner of the palpebral opening
Nasal breadth	al- al	**Alare (al):-** The most external point on the wings of the nose.
Mouth breadth	ch-ch	**Cheilion(ch):-** Outer corner of the mouth; lateral terminus of the oral slit.

(Wilder et al.,1921; Farkas et al., 1984)

Each measurement the smaller dimension as numerator and large dimension as denominator multiplied by 100. The significance of measurements and indices was certainly well understood in understanding the extent of variability and development in certain traits. An index is produced as a follows:

Index = Smaller dimension / Large dimension × 100

The maximum dimension was used as constant denominator and following proportions were worked out.

1. Intercanthal index (ICI) = en-en/ ec-ec×100
2. Biocular nasal width index (BNWI)= ec-ec / al-al×100
3. Intercanthal nasal width index(ICNWI) = en-en/al- al ×100
4. Nose -facial width index (NFWI)= al-al/ zy-zy ×100
5. Nose –mouth width index (NMWI)= al-al/ ch-ch ×100
6. Mouth face width index (MFWI) = ch-ch/ zy-zy ×100
7. Mouth width index (MWI) = ch-ch / ec-ec ×100

Values for each measurement was tabulated and analyzed by SPSS Statistical software 20 version/PC after all the measurements were taken.

Results

The Phenotypic variables have been expressed in table no 1 to 8 for Brahmins and Vaishyas male and female of Lucknow Region. The descriptions of both communities are hereby interpreted comparatively as further distinct phenotypic variables viz. Ethnic variance in different face measurements, Ethnic variance in different face measurements, independent t' Test for variance Indices calculated from different facial measurements, Ethnic differences in various face indices.

Table 1 Comparison of Mean of various facial measurements among Brahmin (males and females)

S. No	Measurements	Male		Female		Value of 't'	*P* value
		MeanX_1 (in cm)	SD X_1	MeanX_2 (in cm)	SD X_2		
1	zy-zy	11.51	0.44	11.67	0.33	-2.97	0.00**
2	en-en	2.86	0.25	2.93	0.21	2.29	0.02*
3	ec-ec	8.37	0.37	8.60	0.38	-4.34	0.00**
4	al-al	3.73	0.24	3.67	0.21	1.97	0.05*
5	ch-ch	4.75	0.38	4.77	0.34	-0.38	0.70

Significant at $p<0.05$ level*, Highly Significant at $p<0.001$ level **

In some face measurements the result is non-significant while in majority the result is significant. It has been observed from the table shows that on average Bizygomatic Breadth of males is (*M*= 11.51, SD= 0.44) and (*M* =11.67, *SD*= 0.33) among Brahmin females. Thus, the *t* value obtained is (-2.97) with *p* value (0.00**). Hence this difference is highlysignificant as *p* value is less than 0.001.

Interocular breadth of males is (*M* = 2.86, SD= 0.25) and (*M* =2.93, *SD*= 0.21) among Brahmin females. Thus, the *t* value obtained is (2.29) with *p* value (0.02*). Therefore, this difference is significant as *p* value is less than 0.05. Binocular breadth of males is (*M* = 8.37, SD= 0.37) and (*M* =8.60, *SD*= 0.38) among Brahmin females. Thus, the *t* value acquired is (-4.34) with *p* value (0.00**). This difference is highly significant since *p* value is less than 0. 001.Nasal breadth of males is (*M* = 3.73, SD= 0.24) and (*M* =3.67, *SD*= 0.21) among Brahmin females. Thus, the *t* value obtained is (1.97) with *p* value (0.05*). Hence, this difference is significant as *p* value is less than 0.05.

Table 2: Independent 't-test for different Indices calculated from different facial measurements among Brahmin (male and female) of Lucknow Region for Gender differences

S.No	Indices	Male		Female		Value of 't'	Significant value
		Mean X_1	SD X_1	Mean X_2	SD.X_2		
1	ICI	34.16	2.64	34.17	2.23	-0.00	0.99
2	ICNWI	76.74	7.46	80.25	7.52	-3.31	0.00**
3	BNWI	44.67	2.75	42.74	2.63	5.06	0.00**
4	NFWI	32.46	2.02	31.46	1.83	3.64	0.00**
5	NMWI	78.93	5.91	77.23	5.90	2.02	0.04*
6	MWI	56.84	4.74	55.56	4.39	1.97	0.05 *
7	MFWI	41.33	3.10	40.90	3.12	-0.97	0.33

Significant at p<0.05 level*, Highly Significant at p<0.001 level **

In some indices the result is insignificant while in majority the result is significant ICNWI has *t* value (-3.31) with *p* value (0.00**) among the Brahmin males and females. Therefore, this difference is highly significant as *p* value is less than 0.001.

BNWI has *t* value (5.06) with *p* value (0.00**) among the Brahmin males and females. Thus, this difference is highly significant because *p* value is less than 0.001.

NFWI has *t* value (3.64) with *p* value (0.00**) among the Brahmin males and females. Therefore, this difference is highly significant because *p* value is less than 0.001.

NMWI has *t* value (2.02) with *p* value (0.04*) among the Brahmin males and females. Thus, this difference is significant since *p* value is less than 0.05.

MWI has *t* value (1.97) with *p* value (0.05*) among the Brahmin males and females. Hence, this difference is significant as *p* value is less than 0.05.

Table - 3 Comparison of mean of various facial measurements among Vaishya (males and females)

S.No	Measurements	Male		Female		Value of 't'	*p* value
		Mean (in cm) X_1	SD X_1	Mean (in cm) X_2	SD X_2		
2	zy-zy	11.54	0.42	11.58	0.42	-0.69	0.48
3	en-en	2.92	0.27	2.94	0.25	0.05	0.95
4	ec-ec	8.36	0.41	8.33	0.63	-0.31	0.75
5	al-al	3.83	0.27	3.62	0.25	5.78	0.00**
9	ch-ch	4.82	0.33	4.60	0.34	3.30	0.00**

*Significant at $p<0.05$ level, **Highly Significant at $p<0.001$ level

Illustrates the data that has been subjected to test of significance (t-test) in order to access the gender differences in different face measurements among the Vaishya males and females of Lucknow region.

Nasal breadth of Vaishya males is ($M = 3.83$, SD= 0.27) and ($M = 3.62$, $SD = 0.25$) among females. Thus, the t value obtained is (5.78) with *p* value (0.00**). Therefore, this difference is highly significant since *p* value is less than 0.001.

Mouth breadth of Vaishya males is ($M = 4.82$, SD= 0.33) and ($M = 4.60$, $SD = 0.34$) among females. Thus, the t value acquired is (3.30) with *p* value (0.00**). This result is highly significant because *p* value is less than 0.001.

Table 4 Gender differences in different face indices among Vaishya malesand females of Lucknow Region

S.No	Indices	Male		Female		Value of 't'	*p* value
		Mean X_1 (cm)	SDX_1	Mean X_2 (cm)	SD X_2		
1	ICI	34.88	2.45	34.81	2.25	0.21	0.83
2	ICNWI	76.37	7.41	81.02	7.59	-4.38	0.00**
3	BNWI	45.88	3.25	43.15	2.86	6.30	0.00**
4	NFWI	33.25	2.35	31.26	2.09	6.30	0.00**
5	NMWI	79.77	6.31	77.90	6.27	2.10	0.03*
6	MWI	57.67	3.86	55.58	3.98	3.76	0.00**
7	MFWI	41.81	3.03	40.29	3.11	3.50	0.00**

*Significant at $p<0.05$ level, **Highly Significant at $p<0.001$ level

The significant Facial Proportion indices having *t* value are: ICNWI of Vaishya males is (*M* = 76.37, SD= 7.41)and (*M* =81.02, *SD*= 7.59) among females. Thus, the t value obtained is (-4.38)with *p* value (0.000**), this result is highly significant as *p* value is less than 0.001

BNWI of Vaishya males is (*M* = 45.88, SD= 3.25) and (*M* =43.15, *SD*= 2.86) among females. Thus, the t value obtained is (6.30) with *p* value (0.000**). Hence this difference is highly significant as *p* value is less than 0.001.

NFWI of Vaishya males is (*M* = 33.25, SD= 2.35) and (*M* =31.26, *SD*=2.09) among females. Thus, the t value obtained is (6.30) with *p* value (0.000**), Hence this difference is highly significant as *p* value is less than 0.001.

NMWI of Vaishya males is (*M* = 79.77, SD= 6.31) and (*M* =77.90, *SD*= 6.27) among females. Thus, the t value obtained is (2.10) with *p* value (0.03*), therefore this difference is highly significant as *p* value $p<0.001$.

MWI of Vaishya males is (*M* = 57.67, SD= 3.86) and (*M* =55.58, *SD*= 3.98) among females. Thus, the t value obtained is (3.76) with *p* value (0.000**), $p<0.001$.

MFWI of Vaishya males is (*M* =41.81, SD= 3.03) and (*M* =40.29, *SD*= 3.11) among females. Thus, the t value obtained is (3.50) with *p* value (0.000**). Hence this difference is highly significant as *p* value is < 0.001.

Table 5: Ethnic variance in different face measurements among Brahmin and Vaishya males of Lucknow Region

S. No	Measurements	Brahmin Males		Vaishya males		Value of 't'	P value
		Mean X_1 (cm)	SD X_1 (cm)	Mean X_1 (cm)	SD X_1 (cm)		
1	zy-zy	11.51	0.44	11.54	0.42	-0.48	0.62
2	en-en	2.86	0.25	2.92	0.27	-1.62	0.10
3	ec-ec	8.37	0.37	8.36	0.41	0.01	0.98
4	al-al	3.73	0.24	3.83	0.27	-2.73	0.00**
5	ch-ch	4.75	0.38	4.82	0.33	-1.36	0.17

*Significant at $p<0.05$ level, **Highly Significant at $p<0.001$ level.

Table 5- illustrates the data that has been subjected to test of significance (t-test) in order to access the Ethnic differences in different face measurements among the Brahmin and Vaishya males of Lucknow region. In some measurements the result is significant while in majority the result is non-significant.

Among Brahmin and Vaishya males, the ethnic differences are significant at $p<0.05$ for facial proportion measurements for Nasal Breadth of Vaishya males is (M =3.83cm, $SD=0.27$) and (M = 3.73cm, SD= 0.24) among Brahmin males. Thus, the t value found is (-2.73) with p value (0.00**). This result is highly significant because p value is less than 0.001.

Table 6: Ethnic variance in different face measurements among Brahmin and Vaishya females of Lucknow Region

S.No	Measurements	Brahmin females		Vaishya females		Value of 't'	*P* value
		Mean X_1 (cm)	SD X_1 (cm)	Mean X_1 (cm)	SD X_1 (cm)		
1	zy-zy	11.67	0.33	11.58	0.42	1.71	0.08
2	en-en	2.93	0.21	2.92	0.25	0.53	0.59
3	ec-ec	8.60	0.38	8.38	0.39	3.88	0.00**
4	al-al	3.67	0.21	3.62	0.25	1.58	0.11
5	ch-ch	4.77	0.34	4.66	0.34	2.23	0.02*

Significant at p<0.05 level, ** Highly Significant at p<0.001 level.

Table-6. presents the data that has been subjected to test of significance (t-test) in order to access the Ethnic differences in different face measurements among the Brahmin and Vaishya females of Lucknow region. In some measurements the result is significant while in majority the result is non-significant.

Among Brahmin and Vaishya females, the ethnic differences are significant at p<0.05 for facial proportion measurements for Binocular breadth of Brahmin females is (M = 8.60 cm, SD= 0.38) and (M =8.38 cm, SD=0.39) among Vaishya females. Thus, the t value obtained is (3.88) with *p* value (0.00**). Hence this difference is highly significant since *p* value is less than 0.001.

Mouth breadth of Brahmin females is (M = 4.77 cm, SD= 0.34) and (M =4.66 cm, SD=0.34) among Vaishya females. Thus, the t value obtained is (2.23) with *p* value (0.02*). Hence this difference is significant since *p* value is less than 0.05.

Table 7: Independent 't' Test for variance Indices calculated from different facial measurements among Brahmin and Vaishya males of Lucknow Region for Ethnic differences

S.No	Indices	Brahmins Male		Vaishyas Male		Value of 't'	*p* value
		Mean X_1	SD X_1	Mean X_2	SD X_2		
1.	ICI	34.16	2.64	34.88	2.45	-1.99	0.08
2.	ICNWI	76.74	7.46	76.37	7.41	0.35	0.72
3.	BNWI	44.67	2.75	45.88	3.25	-2.82	0.00**
4.	NFWI	32.46	2.02	33.25	2.35	-2.55	0.01*
5	NMWI	78.93	5.91	79.77	6.31	-0.97	0.33
6	MWI	56.84	4.74	57.67	3.86	-1.35	0.17
7	MFWI	41.33	3.10	41.81	3.03	-1.10	0.27

*Significant at *p*<0.05 level, **Highly Significant at *p*<0.001 level.

Table 7- illustrates the data that has been subjected to test of significance (t-test)in order to access the Ethnic differences in different face indices among the Brahmin and Vaishya males of Lucknow region. In some indices the result is significant while in majority the result is non-significant. Among Brahmin and Vaishya males, the ethnic differences are significant at p<0.05 for facial proportion indices for BNWI of Vaishya males is (*M* =45.88, *SD*=3.25) and (*M* = 44.67, SD= 2.75) among Brahmin males. Thus, the *t* value obtained is *t* (-2.82) with *p* value (0.00**). Therefore, this difference is highly significant as *p* value is less than 0.001.

NFWI of Vaishya males is (*M* =33.25, *SD*=2.35) and (*M*= 32.46, SD= 2.02) among Brahmin males. Thus, the *t* value obtained is (-2.55)with *p* value (0.01*). This result is therefore significant as *p* value is less than 0.0

Table 8- Ethnic differences in various face indices among Brahmin and Vaishya Females of Lucknow Region

S.No	Indices	Brahmin Females		Vaishya Females		Value of t	*P* value
		Mean X_1	SD_1	Mean X_2	SD_2		
1	ICI	34.17	2.23	34.81	2.25	-2.03	0.04*
2	ICNWI	80.25	7.52	81.02	7.59	-0.72	0.47
3	BNWI	42.74	2.63	43.15	2.86	-1.03	0.30
4	NFWI	31.46	1.83	31.26	2.09	0.72	0.46
5	NMWI	77.23	5.90	77.90	6.27	-0.76	0.44
6	MWI	55.56	4.39	55.58	3.98	-0.03	0.97
7	MFWI	40.90	3.12	40.29	3.11	1.39	0.16

*Significant at $p<0.05$ level, **Highly Significant at $p<0.001$ level.

Table 8- demonstrates the data that has been subjected to test of significance (t- test) in order to access the Ethnic differences in different face indices among the Brahmin and Vaishya Females of Lucknow region. In some indices the result is significant while in majority the result is non-significant.

Among Brahmin and Vaishya females, the ethnic differences are significant at $p<0.05$ for facial proportion indices for ICI of Brahmin females is (*M* = 34.17, SD= 0.23) and (*M* =34.81, *SD=2.25*) among Vaishya females. Thus, the *t* value obtained is (-2.03) with *p* value (0.04*). Hence this difference is significant since *p* value is less than 0.05.

Discussion

The present study provides us with the personal identification on the basis of photographic metrically. For this two endogamous caste groups of Lucknow region Brahmins and Vaishyas of Uttar Pradesh were chosen from the population. The data related to the various indices of face biometrics can be compared with the studies done earlier to arrive at any conclusion.

The present study, which was carried out on 400 subjects, 200 Brahmins and 200 Vaishyas (100 males and 100 females each) under the age group of 18-40 year for 7face indices of frontal face were considered and the overall accuracy achieved through all statistically significant Facial

proportion indices was 87.8%. The total cumulative variance is 86.4% for Brahmin males, 87.5% for Brahmin females, 88.4% for Vaishyas male, 89.1% for Vaishyas female. So, the result of the present study shows approx similarity with the result of Ivancevic, & Sunde study.

Aksua et al., (2010) in their work Reliability of reference distances used in photogrammetry have presented the values of various measurements. To obtain the mean value for Ex-Ex was (9.40±0.36 cm) males, (9.10 ±0.36cm) females and en-en (3.41± 0.23cm) males and (3.30± 0.26cm) females, al-al (3.94 ± 0.27cm) males, (3.57 ±0.23) females, ch-ch (5.29 ± 0.32cm) males and (4.97± 0.37cm) females. While in the present study, the result showed the mean values for ec-ec, en-en, al-al, ch-ch was (8.37±0.37cm), (2.86±0.25cm), (3.73±0.24), (4.75±0.38m) respectively in Brahmin males, On the other hand in Brahmin females these values were respectively, (8.60±0.38cm), (2.93±0.21cm), (3.67±0.21cm), (4.77±0.34cm). However, in Vaishya males these values were respectively (8.36±0.41cm), (8.36±0.4cm), (12.92±0.27cm), (4.55±0.39cm), (5.64±0.50cm), (3.83±0.27cm), (4.82±0.33cm), However in Vaishya females these values were respectively (8.33±0.63cm), (2.94±0.25cm), (4.65±0.36cm), (5.41±0.43cm), (3.62±0.25cm), (4.60±0.34cm) these measurements were found statistically significant for sex differences among Brahmin and Vaishya communities of Lucknow region. Therefore, the result of the present study shows similarity with the result of Aksua study.

Morosini et al., (2012) in their work Study of face pleasantness using facial analysis in standardized frontal photographs have presented the values of various measurements and indices. The sample consisted of frontal and lateral standard facial photographs, in natural head position, of 85 Brazilian Caucasian women to obtain mean values were Facial index: (84.70, SD 3.59), en-en (3.35cm SD 0.25), al-al (3.63cm SD0. 31), ch-ch (5.02cm SD 3.75). However, under the present study, which was carried on 400 subjects, 200 Brahmins and 200 Vaishyas (100 male and 100 female) under the age group of 18-40 year for 13 face measurements of frontal face were considered and obtain mean values were Interocular breadth is (2.93cm, SD 0.21± 0.02) among Brahmin females and Vaishya females (2.92cm, SD 0.25± 0.02). The mean value for Nasal breadth is (3.67cm, SD 0.21±0.02) Brahmin females and Vaishya females (3.62cm, SD 0.25±0.02). The mean value for Mouth breadth is (4.77 cm, SD 0.34±0.03) Brahmin females and Vaishya females (4.60cm, SD 0.34±0.03). Brahmin females and Vaishya females (0.50 cm, SD 0.14±0.01). So, the result of the present study shows similarity with the result of Morosini study.

Kalra et al., (2015), in their work Evaluation of various anthropometric proportions in Indian beautiful faces: A photographic study has presented the values of various indices. Frontal photographs of 30 females. The frontal face indices of results showed the mean values for ICNWI, NMWI, MFWI was respectively, (86.01 ±7.03cm), (69.86±6.40cm), (37.63± 3.02cm) for frontal face in the young women. However, in the present study, the results showed the mean and t test values for ICNWI, NMWI, MFWI is respectively, (80.25±7.52cm), (77.23±5.90cm), (40.90±3.12cm) for frontal faces in Brahmin females. Similarly, in Vaishya females these values are respectively, (87.07±5.18cm), (78.15±7.78cm), (40.29±3.11cm) for frontal faces these indices are found statistically significant for interpopulation differences among Brahmin and Vaishya communities of Lucknow region. Thus, the result of the present study shows similarity with the result of Kalra study.

Negi et al., (2017) in their work Photogrammetric Correlation of Face with Frontal Radiographs and Direct Measurements have presented the values of various measurements. The study was conducted on 30 subjects of Indian origin. Standardized frontal photographs were obtained from subjects in the age group of 18-25 years and to obtain mean values are en-en (3.16cm, SD 0.39±0.12), ex-ex (9.54cm, SD 0.45±0.14), zy-zy (12.1cm, SD 0.64±0.20), al-al (3.52cm SD 0.37±0.11). While in the present study, which was carried on 400 subjects, 200 Brahmins and 200 Vaishyas (100 male and 100 female) under the age group of 1840 year for 13 facial measurements on Standardized frontal facial photographs. The mean value for Interocular breadth is (2.86cm SD 0.25±0.02) among Brahmin males and Brahmin females (2.93cm, SD 0.21± 0.02). Vaishya males (2.92cm, SD0.27±0.02) and Vaishya females (2.92cm, SD 0.25± 0.02). The mean value for Binocular breadth is (8.37cm, SD 0.37±0.03) Brahmin males, (8.60cm, SD 0.38±0.03) Brahmin females. (8.36, with SD 0.41±0.04) Vaishya males (8.33cm, SD0.63±0.06) Vaishya females. The mean value for Bizygomatic Breadth is (11.51cm, SD 0.44±0.04) Brahmin males and Brahmin females (11.67cm, SD0.33±0.03). Vaishya males (11.54cm, SD 0.42±0.04) and Vaishya females (11.58 cm, SD 0.42±0.04). The mean value for Nasal breadth is (3.73cm, SD 0.24± 0.02) Brahmin males. (3.67cm, SD 0.21±0.02) Brahmin females.

Conclusion

Among all the biometric techniques, face recognition approach possesses one great advantage, which is user-friendliness (non-intrusiveness). All the issues and challenges of personal identification can be solved by different algorithms from the facial biometric.

After the analysis of mean values data were subjected to test of significance (t-test) to assess the gender differences among the Brahmins and Vaishyas communities of Lucknow. Test of significant (t-test) at the level of $p<0.05$ revealed significant gender differences (Intrapopulation) for photometric measurements among the Brahmin (males and females) except for Bizygomatic Breadth (*P*value = 0.00), Interocular breadth (*P*value = 0.02), Binocular breadth (0.00), Nasal breadth (*P*value = 0.05), which are observed significant among male and female Brahmins.

Test of significant (t-test) at the level of $p<0.05$ revealed significant gender differences (Intrapopulation) for facial photometric measurements among the Vaishya (males and females) for Nasal breadth (*P*value = 0.00), Mouth breadth (*P*value = 0.00), which are observe significant among Vaishya males and females.

After the analysis of mean values data were subjected to test of significance (t-test) to assess the gender differences among the Brahmins community of Lucknow. Test of significant (t-test) at the level of $p<0.05$ revealed significant gender differences (Intrapopulation) for facial proportion indices among the Brahmin (males and females) for ICNWI (*P*value =0.00), BNWI (*P*value = 0.00), NFWI (*P*value = 0.00), NMWI (*P*value = 0.04), MWI (*P*value = 0.05), which are seen to be significant among males and females Brahmin.

Test of significant (t-test) at the level of $p<0.05$ revealed significant gender differences (Intrapopulation) for facial proportion indices among the Vaishyas (male and female) for ICNWI (*P*value = 0.00), BNWI (*P*value = 0.00), NFWI (*P*value = 0.00), NMWI (*P*value = 0.03), MWI (*P*value = 0.00), MFWI (*P*value = 0.00), which are observed significant among male and female Vaishyas.

Test of significant (t-test) to access the ethnic differences among Brahmins and Vaishyas male of Lucknow region. It is apparent from the values of t-test that the ethnic differences are significant at the level of $p<0.05$ in the facial proportion indices for ICNWI (*P*value = 0.00), NFWI (*P*value = 0.01), which are seen significant among males Brahmins and Vaishyas.

Among Brahmins and Vaishyas females, the ethnic differences are significant at $p<0.05$ for facial proportion indices for ICI (*P*value = 0.04), which are seen to be significant among females, which are seen to be significant.

In this research the rare and common facial characteristics in communities of Brahmins and Vaishyas of Lucknow region were identified. The result is compared with several statistical techniques such as mean, range, t test, and proposed technique gives a better recognition rate than

the other techniques. The 't' tests revealed intrapopulation and interpopulation significant difference in most of the measurements, indices. Hence face of a person holds utmost importance and it should be studied first of all because the human face is the reflection of individual uniqueness of a person.

References

Aksu, M., Kayab, D., Kocaderelic, I., (2010). Reliability of reference distances used in photogrammetry, Angle Orthodontist, Vol. 80, No 4. pp 670-677

Alspaugh, D. (2004). A brief history of photogrammetry," in Manual of Photogrammetry, 5th ed., J.C. McGlone, Ed. Bethesda, MD: American Society for Photogrammetry and Remote Sensing, pp. 1- 12.

Beham, M.P., Roomi, S.M.M., (2013). A review of face recognition methods. International Journal of Pattern Recognition and Artificial Intelligence 27(4)

Brunelli, R. and Poggio, T., (1993). Face Recognition: Features versus Templates. IEEE Transactions on Pattern Analysis and Machine Intelligence, 15(10):1042-1052.

Farkas, L. G., Katie, M. J., Hreczko, T. A. and Munro, I. R. (1984). Anthropometric proportions in the upper lip-lower lip and chin area of lower face in young white adults, Am. J. Orthod., Volume 86, Number 1.

Fromherz, T., Stucki, P., Bichsel, M. (1997). A Survey of Face Recognition, MML Technical Report, vol. 97, pp. 1-18,

Goldstein, A.J., Harmon, L.D., and Lesk, A.B., (1971). Identification of human faces, Proc. IEEE, vol. 59, pp. 748, 1971.

Hiremani, V. A., Hatture, S. M., (2013). Personal Identification with Face Biometrics using Color Local Texture Features, International Journal of Advanced Computer Research, Volume-3 Number-2 pp.138-145.

Ivancevic, V., Kaine, A. K., Mclindin, B. A. & Sunde, J., (2003). Factor analysis of essential facial features. International conference on information technology interfaces.

Nefian, A. and Hayes, M. (1998), Hidden Markov Models for face recognition, in Proc. IEEE Int.Conf. Acoustics, Speech, and Signal Processing, ICASSP'98, Vol. 5, Washington, USA, pp. 2721- 2724.

Ramchandra, A. and Kumar, R., (2011). Algorithms of feature-based and image-based Face Recognition, Indian journal of applied research 3 (12):128-130

Roelofse, M.M., Steyn, M. and Becker, P.J. (2008). Photo identification: Facial metrical and morphological features in South African males, Forensic Sci. Int. 177 168-175.

Sohail, A.S.M. and Bhattacharya, P. (2006). Localization of Facial Feature Regions using Anthropmetric Face Model, Int. Conf. on Multidisciplinary Information Sciences and Technologies.

Sumathi, S. and Malini, R. H. (2011). An Overview of Leading Biometrics for Human Identity, Proceedings of the

5th National Conference; INDIACom-2011 Computing For Nation Development, Bharati Vidyapeeth's Institute of Computer Applications and Management, New Delhi.

Wilder, Harris H., (Eds.), (1921). A Laboratory Manual of Anthropometry, Philadelphia P. Blakiston Son and Co.