PHOTOGRAMMETRIC STUDY OF PROSOPIC INDEX IN CENTRAL INDIA FOR SEXUAL DIMORPHISM

Manish Malhotra, Bhupeshkumar Nanhe, Navjot Kaur Kanwal

Corresponding author, Scientist B, Physics Division, Central Forensic Science Laboratory, Bhopal, Madhya Pradesh, India, malhotraforensics@gmail.com

Assistant Professor, Department of Forensic Science, Shri Shivaji College of Arts, Commerce and Science, Akola, Maharashtra, India bhupunanu@gmail.com

Assistant Professor Department of Criminology and Forensic Science, Dr. Harisingh Gour University, Sagar, Madhya Pradesh, India. kanwalnk@gmail.com

Abstract

Objective: Anthropometric data of facial dimensions plays a vital role in facial reconstructive surgeries, forensics and medicine. This study was aimed to observe the variations of Prosopic Index among people of Central India and to compare the findings of the study with previously published data using 2D photogrammetry. The present study was done on 150 adults with equal number of males and females in Sagar district of Madhya Pradesh, India. Prosopic Index was obtained by taking linear measurements using ImageJ image processing software. Parametric t-test was applied to obtain p values for studying significant differences between mean values of Prosopic Index for both the gender. Mean PROSOPIC INDEX value for male was observed to be 83.47±4.81 and for females 78.94±4.01. It can be concluded from the present study that there is sexual dimorphism in Prosopic Index of the individuals of Central India in which the males have mostly Euryprosopic face (Broad) whereas females have mostly Hypereuryprosopic face (very broad).

Keywords: Anthropometry, Forensic Science, Landmarks, Prosopic Index, Prosopic Index, 2D photogrammetry.

INTRODUCTION

Anthropometry is derived from the words 'anthropos' and 'metron' which when combined means measurements on human body [1,2]. Photogrammetry is the method of taking measurements from photographs [3]. To expand the knowledge on anthropometric dimensions of humans, when the measurements are done on the photographic images of individuals or human body parts known as photo anthropometry.

Measurements of any parts of the body vary amongst individuals as well as races [2]. The growth and development of humans are influenced by many components that include factors such as their geographical distribution, race, gender and age [4,5].

Information of the absolute and relative variability in the size and shape of human body is essential to study human growth, population variation and medico legal identification in forensics as well as required in the streamlining of industrial instruments such as respirators, protective masks and military helmets [6].

The Prosopic Index that is expressed as the percentage ratio of morphological face height to face width, is a standout amongst the most regularly utilized anthropometric parameters in classifying human races. Not only the race but also sex of an individual or group whose identity is obscure, might be determined with the help of Prosopic Index [7]. Additionally, it is been used in reconstructive and plastic surgeries.

Through the present study, an attempt is been made to assess the possibility of determining the sex of an individual with the help of Prosopic Index along with comparing the current observations with the previously published data.

MATERIALS AND METHODS

Photographs of 150 students (75 Males and 75 Females) aged 20-30 years were taken in Sagar district of Madhya Pradesh state of Central India. Cases of dental and facial reconstructive surgeries and subjects with major facial deformities were excluded for the present study. Verbal information about the study was given to all subjects and informal consent was obtained from them prior to initiating the study.

A measuring setup was created by placing a chair against a wall and keeping the camera on a tripod approximately at 1 metre distance from the subject. Digital 2D photographs were taken using an 18 Mega Pixel DSLR camera (Make: Canon, Model: EOS 1200D). Photographs of all subjects were taken under similar light conditions in same room and on same chair. Lens of the camera was adjusted in such a manner that it remains

parallel to the face of subject while subject remain seated with head in Frankfort plane horizontal to the floor. Measurements were taken on photographs by using Image J software (version 1.51j8), an open-source image processing program designed for scientific multidimensional images.

3 classical facial anatomical landmarks i.e., nasion (n), gnathion (gn) and photographic zygion (pzy) were taken in account (Fig. 1). As zygion is not accurately localized in photographs, photographic zygion (pzy) was used in the present photogrammetric method instead of zygion (zy) as done by Franke-Gromberg et al., 2010 [8].

The linear measurements were taken in pixel values using Image J software and then converted into Indices. Prosopic Index was derived from the linear measurements for each subject by digital 2D photogrammetric method. The derivation of the Prosopic Index was done by same observer. Values of mean and standard deviation were evaluated for both genders using GraphPad Prism 5.
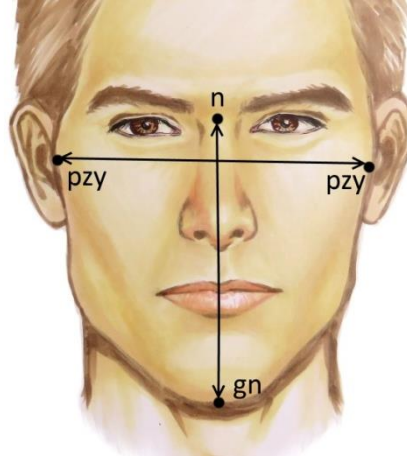

Figure 1: Landmarks chosen and linear measurements taken between them for the present study.

ANALYSIS

The Prosopic Index was calculated for each individual of both gender groups using following formula.

▪ Prosopic Index = morphological facial height (n-gn) X 100/face width (pzy-pzy)

The face was classified according to the Banister's Classification [9] for both gender groups as per Table 1.

Face Shape	PROSOPIC INDEX
Hyper Euryprosopic (Very Broad)	≤ 78.9
Euryprosopic (Broad)	79.0 to 83.9
Mesoprosopic (Medium)	84.0 to 87.9
Leptoprosopic (Narrow)	88.0 to 92.9
Hyper Leptoprosopic (Very Narrow)	≥ 93.0

Table 1: Face shapes and relative Morphological Face Index.

Finally, the whole data obtained was scrutinized, tabulated and analysed statistically using GraphPad Prism 5 by applying unpaired two tailed student's t-test with 95% confidence intervals. A p value of <0.05 was considered to be statistically significant and <0.0001 as highly significant.

RESULTS AND DISCUSSION

The measurements showed that the Prosopic Index was 83.47±4.8 for the male individuals and 78.94±4.0 for female. Prosopic Index for both Males and Females was found statistically highly significant (p<0.0001) (Table 2). On the basis of calculations made on Prosopic Index, it was found that the facial shape type was Euryprosopic (Broad) in male individuals, while it was Hypereuryprosopic (very broad) in female individuals of Central India. Facial shape of men was observed to be comparatively larger than women due to more growth in men. In the present study, 16% of Males and 60% Females had Hypereuryprosopic face, 38.7% Males and 25.3% Females had Euryprosopic face, 28% Males and 14.7% Females had Mesoprosopic face, 17.3% Males and 0% Females had Leptoprosopic face while nobody had Hyperleptoprosopic face. According to the current study, the most frequent face shape was found to be Hypereuryprosopic. (Figure 2 and 3)

In the present study, Prosopic Index in males was found to be larger than females that was in accordance with findings of Jahanshahi et al., 2008; Kurnia, 2012; Raji et al., 2010 [4,5,10]. In the present study, it was also

observed that both males and females of Central India had broader face compared to earlier reported data of North-eastern Nigerians, North Iranians (Fars and Turkmans), Nigerians (Fulani, Tangale and Tera), Malay, Chinese & Indians, Malaysian Indians and Chinese [1,2,4,5,10,11] (Table 3 and Figure 4). No study showed Euryprosopic and Hypereuryprosopic face shape of males and females respectively, which clearly shows ethnic differences in Prosopic Index among the people of Central India and other referred populations.

Gender	Mean Prosopic Index	p value
Male	83.47±4.81	<0.0001
Female	78.94±4.01	

Table 2: Statistical analysis of Prosopic Index values for significance.
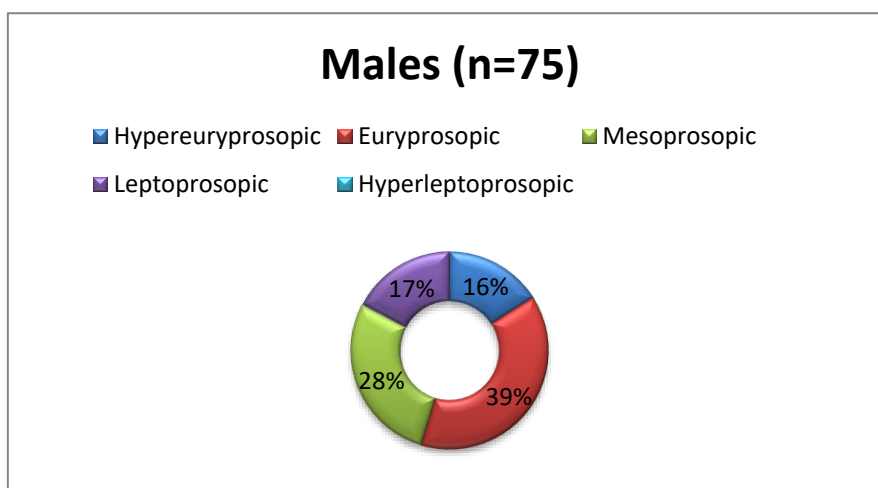

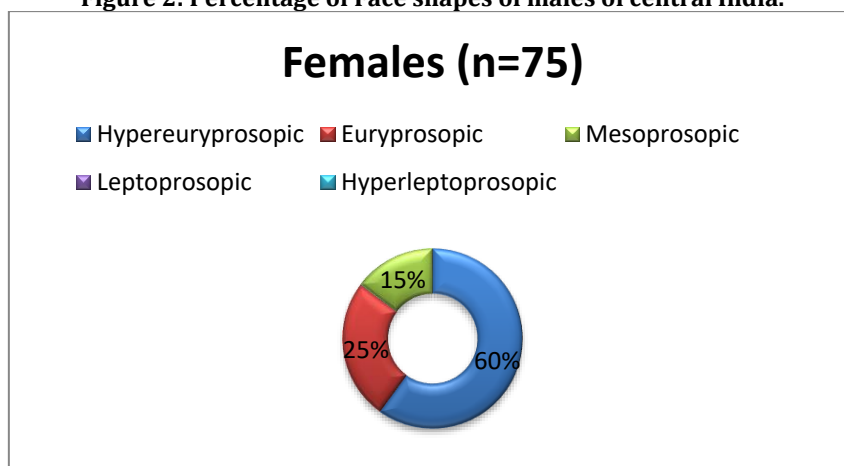**Figure 2: Percentage of Face shapes of males of central India.**

Figure 3: Percentage of Face shapes of females of central India.

Place and people	Reference	Age	Prosopic Index	Face shape
North-eastern Nigeria Males	Raji et al.,, 2010	19-35	99.39	Hyperleptoprosopic
North-eastern Nigeria Females	Raji et al.,, 2010	19-35	97.54	Hyperleptoprosopic
North Iran/Fars Males	Jahanshahi et al., 2008	17-20	88.22	Leptoprosopic
North Iran/Fars Females	Jahanshahi et al., 2008	17-20	84.48	Mesoprosopic
North Iran/Turkman Males	Jahanshahi et al., 2008	17-20	87.25	Mesoprosopic
North Iran/Turkman Females	Jahanshahi et al., 2008	17-20	81.48	Euryprosopic
Nigeria/Fulani Males	Maina et al., 2012	18-40	95.20	Hyperleptoprosopic
Nigeria/Fulani Females	Maina et al., 2012	18-40	100.80	Hyperleptoprosopic
Nigeria/Tangale Males	Maina et al., 2012	18-40	92.10	Leptoprosopic
Nigeria/ Tangale Females	Maina et al., 2012	18-40	92.60	Leptoprosopic
Nigeria/Tera Males	Maina et al., 2012	18-40	94.10	Hyperleptoprosopic
Nigeria/Tera Females	Maina et al., 2012	18-40	100.40	Hyperleptoprosopic
Malay Males	Wai et al., 2015	18-21	87.04	Mesoprosopic
Malay Females	Wai et al., 2015	18-21	90.59	Leptoprosopic

Chinese Males	Wai et al., 2015	18-21	85.90	Mesoprosopic
Chinese Females	Wai et al., 2015	18-21	85.40	Mesoprosopic
Indian Males	Wai et al., 2015	18-21	92.14	Leptoprosopic
Indian Females	Wai et al., 2015	18-21	92.99	Hyperleptoprosopic
Malaysian Indians Males	Ngeow et al., 2009	18-25	85.50	Mesoprosopic
Malaysian Indians Females	Ngeow et al., 2009	18-25	85.40	Mesoprosopic
Chinese Males	Kurnia et al., 2012	20-22	89.50	Leptoprosopic
Chinese Females	Kurnia et al., 2012	20-22	86.70	Mesoprosopic
Central Indians Males	**Present study**	**20-30**	**83.47**	**Euryprosopic**
Central Indian Females	**Present study**	**20-30**	**78.94**	**Hypereuryprosopic**

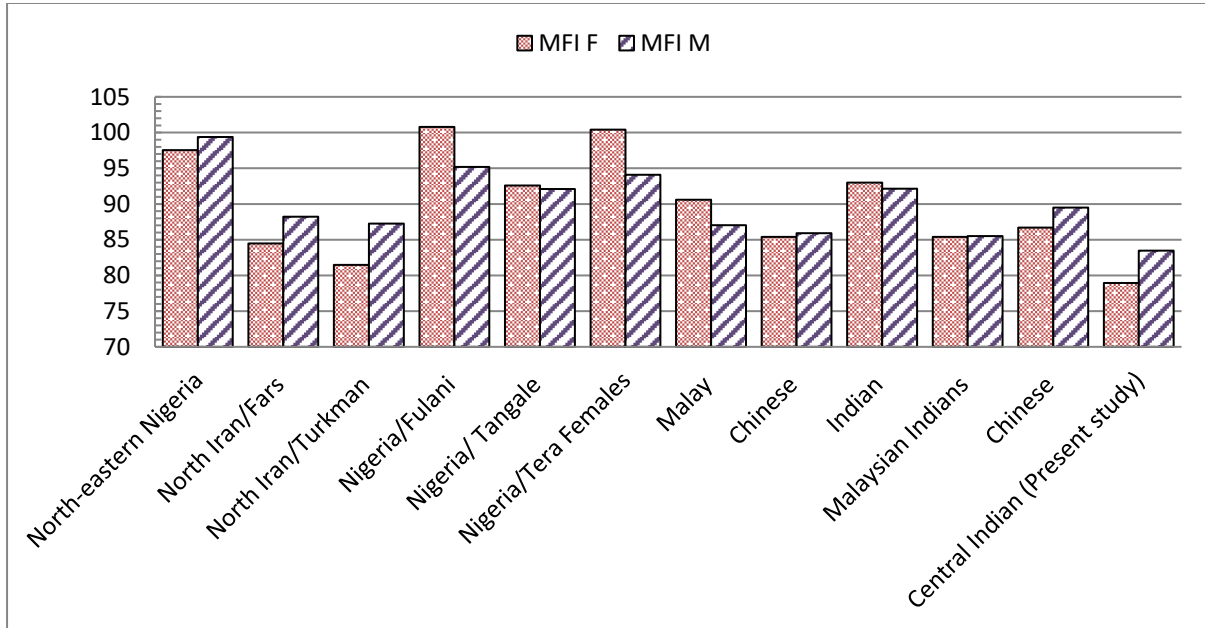**Table 3: Comparison of Prosopic Index among different populations.**

Figure 4: Comparison of Prosopic Index with other populations.

CONCLUSION AND FUTURE DIRECTIONS

It can be concluded from the present study that there is sexual dimorphism in Prosopic Index of the individuals of Madhya Pradesh state of Central India. The males have mostly Euryprosopic face (Broad) whereas females have mostly Hypereuryprosopic face (very broad). There is dominance of Hypereuryprosopic face shape and absence of Hyperleptoprosopic face shape amongst the population in Central India considered in the present study. The study can be extended to generate large databases throughout India for establishing normative for facial Indices. The study would be highly useful in Forensic Physics for identification of diverse population by using anthropometric parameters in all over world.

DECLARATION OF INTEREST

None

FUNDING

REFERENCES

[1]   W.C. Ngeow, S.T. Aljunid, Craniofacial anthropometric norms of Malays, Singapore Med. J. 50 (2009) 525.
[2]   M.M. Wai, S.S. Thwin, T. Yesmin, A. Ahmad, A.S.S. Adnan, A.A. Hassan, N. Ahmad, N.I. Zakariah, Nasofacial anthropometric study among university students of three races in Malaysia, Adv. Anat. 2015 (2015).
[3]   M. Malhotra, N.K. Kanwal, Implications of Facial Photogrammetry and Photomorphology : A Review, Int. J.

Innov. Sci. Eng. Technol. 4 (2017) 269–278. http://ijiset.com/vol4/v4s2/IJISET_V4_I02_35.pdf.

[4] M. Jahanshahi, M.J. Golalipour, K. Heidari, The effect of ethnicity on facial anthropometry in Northern Iran, Singapore Med. J. 49 (2008) 940–943.

[5] C. Kurnia, S. Susiana, W. Husin, Facial indices in Chinese ethnic students aged 20-22, J. Dent. Indones. 19 (2013) 1–4.

[6] N. Khan, V. Leela, G. Annavarapu, A study of craniofacial anthropometrics in Hyderabad (Deccan)-and a review of literature, J. Med. Allied Sci. 2 (2012) 54.

[7] Z. Zhuang, D. Landsittel, S. Benson, R. Roberge, R. Shaffer, Facial anthropometric differences among gender, ethnicity, and age groups, Ann. Occup. Hyg. 54 (2010) 391–402.

[8] C. Franke-Gromberg, G. Schüler, M. Hermanussen, C. Scheffler, Digital 2D-photogrammetry and direct anthropometry–a comparing study on test accomplishment and measurement data, Anthropol. Anzeiger. 68 (2010) 11–20.

[9] T. Yesmin, S.S. Thwin, S. Afrin Urmi, M.M. Wai, P.U. Zaini, K. Azwan, A study of facial index among Malay population, J. Anthropol. 2014 (2014).

[10] J.M. Raji, S.H. Garba, A.I. Numan, M.A. Waziri, M.B. Maina, Morphological evaluation of head and face shapes in a North-Eastern Nigerian population, Aust J Basic Appl Sci. 4 (2010) 3338–3341.

[11] M.B. Maina, O. Mahdi, G.G. Kalayi, Craniofacial forms among three dominant ethnic groups of Gombe State, Nigeria, Int J Morphol. 30 (2012) 211–216.

https://www.gapijfbs.org/