Anthropologist 31(1-3): 80-85 (2018)
DOI: 10.31901/24566802.2018/31.1-3.1861

Gender Differential of Craniofacial Measurements among University Students in Japan

ASMA Mamun[1], Golam Hossain[1], Pete E. Lestrel[2] and Premananda Bharati[3]

[1]Health Research Group, Department of Statistics, University of Rajshahi, Rajshahi-6205, Bangladesh
[2]Formerly, Sections of Orthodontics and Oral Biology, School of Dentistry, University of California, 10883, USA
[3]Formerly, Biological Anthropology Unit, Indian Statistical Institute, 203, B.T. Road, Kolkata – 700 108 West Bengal, India
E-mail: [1]<mithun_stat@yahoo.com>, [1]<hossain95@yahoo.com>, [2]<peter.lestrel@gmail.com>, [3]<pbharati@gmail.com>

KEYWORDS Cephalic Index. Face Dimension. Head Dimension. Japanese University Students. Prosopic Index

ABSTRACT Craniofacial measurements are important for forensic medicine, plastic surgery, oral surgery and diagnostic comparisons between patients and normal populations. It is also used to identify ethnic group. The purpose of the current paper was to compare craniofacial measurements between male and female university students in Japan. The sample consisted of 1,215 and 832 male and female university students respectively. The sample was selected from several universities in Tokyo and Kyoto from 1998 to 2001. The majority of the Japanese male (26.19%) and female (30.77%) students' facial shapes were leptoprosopic (long face) with a mean prosopic index of 84.19 for males and 82.66 for females. Also, the majority of the Japanese males (43.09%) and females (35.34%) head sizes were brachycephalic (round headed) with a mean cephalic index of 85.96 for males and 85.21 for females. All craniofacial measurements and indices of males were significantly higher than those of female students.

INTRODUCTION

Craniofacial morphometrics provide considerable information about physical conditions and development during growth. Craniofacial measurements are also important for pediatrics, forensic medicine, plastic surgery, oral surgery and diagnostic comprehension between patient and normal populations which have been described by William et al. (1995). These measurements provide a good method through which head and face forms can be established by Maina et al. (2012). The cephalic index (CI) and the prosopic index (PI) are generally considered as indicators of human head and face size respectively. The standard human's head shape has been classified as dolicocephalic, brackiocephalic, mesocephalic and hyperbrakicephalic and human's face shapes are hypereuriprosopic, euriprosopic, mesoprosopic, leptoprosopic and hyperleptoprosopic which have been described by William et al. (1995). These various types of head and face shapes are affected by several factors such as ethnicity, ecology, biology, geography, race, gender, age and nutrition (Abbie 1947; Rajlakshmi et al. 2001; Golalipour et al. 2003; Jeyaseelann et al. 2016; Shinde et al. 2016).

In the Asian continent, comparative study in craniofacial measurements between Indian and Malaysian students, and also between different races of the Indian population have been reported in many papers (Shetti et al. 2011; Krishan and Kanchan 2012; Sushma et al. 2013). More recently, craniofacial measurements and indices between ethnic groups and gender for young adults in Nepal have been investigated by Shah et al. (2015). In Japan, prosopic index has been used to find secular change of facial shape for adult Japanese female students over two decades by Hossain et al. (2011). A similar study on the Japanese male population has been observed for determining the influential cranio-

Address for correspondence:
Dr. Premananda Bharati
Biological Anthropology Unit,
Indian Statistical Institute,
203 B.T. Road, Kolkata-700 108
E-mail: pbharati@gmail.com

facial measurements on cephalic index by Hossain et al. (2013). However, comparisons of craniofacial measurements between Japanese university male and female students are poorly documented.

Objective

The aim of this paper was to compare the craniofacial measurements between the adult Japanese male and female students.

METHODOLOGY

In this paper, 1237 healthy male and 832 healthy female university students were considered as a sample. Students were selected from several universities in Tokyo and Kyoto in Japan during the period 1998 to 2001. All measurements were measured by Late Professor Fumio Ohtsuki following the technique described by Martin and Saller (1957). The subjects were of Japanese birth and ancestry with representation from various districts of Japan. The age of the students at the time of measurement was 18-25 years old, with an average age of 19.29 0.98 years.

The following eight craniofacial dimensions were used for analysis: head length, head breadth, head height, head circumference, minimum frontal breadth, bizygomatic breadth, bigonial breadth and morphological facial height. The anthropometric landmarks used for measuring craniofacial measurements are described by Hossain et al. 2011 (Table 1).

Cephalic index (CI) was used to classify the head size of student, and it was calculated from head breadth (HB) and head length (HL), that is,

$$CI = \frac{HB}{HL} X100 \qquad (1).$$

Also, prosopic index (PI) was used to classify sample according their face size, PI was derived from morphological facial height (MFHt) and bizygomatic breadth (BIZB), and it was calculated using the following formula:

$$PI = \frac{MHHt}{BIZB} X100 \qquad (2)$$

Misleading or inaccurate results may be found if any abnormal values exist in a data set. To overcome this problem, abnormal/ outlier's values of data were checked by present authors using informal technique that was described by Dunn and Clark (1974) and Stevens (1996).

Statistical Analysis

Frequency distribution was done to calculate the percentage of each category of head and face shape. The Z-proportional test was utilized in this paper to find the significant difference between two proportions. The test statistic for Z- proportional test is given below:

$$Z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\bar{p}\,(1-\bar{p})\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \qquad (3)$$

±, where $\bar{p}_2$ are the mean of proportion of male and female students respectively, p is the pooled mean of proportion of total samples and n_1 and n_2 are the number of sample of male and female students respectively.

Mean and standard deviations were calculated for all craniofacial measurements. The independent sample t-test was used to determine the difference in craniofacial measurements between male and female students. The test statistic for independent sample t-test is given by

$$t = \frac{\bar{X} - \bar{Y}}{s\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} \sim t_{(n_1+n_2-2)} \qquad (4)$$

Table 1: Anthropometric landmarks used for measuring craniofacial measurements

Measurements	*Landmarks*	
	Beginning	*Ending*
Head length (HL) (mm)	Glabella	Opisthocranion
Head breadth (HB) (mm)	Left eurion	Right eurion
Head height (HHt) (mm)	Vertex	Porion
Head circumference (HC) (cm)	Glabella	Glabella
Minimum frontal breadth (MFB) (mm)	Left frontotemporale	Right frontotemporale
Bizygomatic breadth (BIZB) (mm)	Left zygion	Right zygion
Bigonial breadth (BIGH) (mm)	Left gonion	Right gonion
Morphological facial height (MFHt) (mm)	Nasion	Gnathion

$$s^2 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2 + \sum_{i=1}^{n}(Y_i - \bar{Y})^2}{(n_1 + n_2 - 2)}$$

where, $\bar{X}$ and $\bar{Y}$ are the mean of craniofacial measurements of male and female students, and n_1 and n_2 are the number of sample of male and female students respectively. Statistical analysis was carried out using the Statistical Package for the Social Sciences software (SPSS, version IBM 20). In this paper, $p<0.05$ was considered as significant.

RESULTS

A total number of 2047 (male, 1215 and female, 832) university students in Japan was considered for analysis in the present paper to investigate the difference in craniofacial measurements (head and face dimensions) with cephalic and prosopic index between male and female students.

Gender Differentiate in Different Type of Face Shape

It was noted that the most common type of facial shape of Japanese males was leptoprosopic (26.1%) followed by mespprosopic (24.3%), hypereuryprosopic (23.6%), euryprosopic (17.4%), and hyperleptoprosopic (8.3%). On the other hand the most common type of facial shape of Japanese females was leptoprosopic (30.7%) followed by hypereuryprosopic (23.2%), mesprosopic (21.5%), hyperleptoprosopic (15.0%), and euryprosopic (9.5%). The Z-proportion test demonstrated that the difference in the proportion of euryprosopic ($p<0.01$), leptoprosopic ($p<0.05$) and hyperleptoprosopic ($p<0.01$) between male and female students were significant, while the gender difference in other types of face form were not statistical significant ($p>0.05$) (Table 2).

Gender Differentiate in Different Type of Head Form

The most common type of head form of Japanese adults was brachycephalic, and z-proportional test showed that the number of brachycephalic head form of male students (43.0%) was significantly higher than that of female students (35.3%) ($p<0.01$). It was observed that the number of hyperbrachycephalic form among male students (31.6%) was less than that of female students (33.8%), and the difference was not significant ($p>0.05$). The mesocephalic head form of Japanese male and female students was 13.9 percent and 19.4 percent respectively, and the difference between male and female was significant ($p<0.01$). It was noted that the ultrabrachycephalic head form of male and female university students in Japan was 10.1 percent and 9.8 percent, the difference was significant ($p<0.01$). The number of dolichocephalic form among Japanese male and female university students was 1.2 percent and 1.4 percent, but the gender difference was not significant ($p>0.05$) (Table 3).

Gender Differentiate in Head Dimensions and Cephalic Index

It was noted that the head length of male students (189.6 mm) was significantly ($p<0.01$)

Table 2: Percentage of prosopic index category of Japanese university students

Face dimensions	*Male (%)*	*Female (%)*	*z-value*	*p-value*
Hypereuryprosopic	23.6	23.2	0.2	0.7
Euryprosopic	17.4	9.5	-34.4	0.01
Mesoprosopic	24.3	21.5	1.4	0.1
Leptoprosopic	26.1	30.7	-2.2	0.01
Hyperleptoprosopic	8.3	15.0	30.5	0.01

Table 3: Percentage of cephalic index category of Japanese university students

Head dimensions	*Male (%)*	*Female (%)*	*z-value*	*p-value*
Dolichocephalic	1.2	1.4	-0.9	0.3
Mesocephalic	13.9	19.4	-3.3	0.01
Brachycephalic	43.0	35.3	3.5	0.01
Hyperbrachycephalic	31.6	33.8	-1.1	0.2
Ultrabrachycephalic	10.1	9.8	-39.4	0.01

higher than that of female students (180.1 mm). The head breadth of male students (161.4 mm) was higher than that of female (154.6 mm), and the difference was significant ($p<0.01$). The mean head height of male and female university students were 133.4 mm and 129.5 mm, and the gender difference was significant ($p<0.01$). The mean head circumference of male and female students were 57.2 cm and 55.2 cm respectively and t-test showed that this difference between male and female was significant ($p<0.01$). The mean cephalic index of male (85.9) was significantly higher than that of female students (85.2) ($p<0.01$) (Table 4).

Gender Differentiate in Face Dimensions and Prosopic Index

The mean value of minimum frontal breadth among male and female students was 127.8 mm and 123.1 mm, and the gender difference was significant ($p<0.01$). The mean value of bizygomatic breadth of male students (145.5 mm) was significantly ($p<0.01$) higher than that of female student (138.4 mm). The mean value of bigonial breadth of Japanese male and female students were 96.1 mm and 94.9 mm respectively, and the gender difference was significant ($p<0.01$). The mean value of morphological facial height of male students (122.4 mm) was significantly higher than that of female students (114.4 mm), the difference between these two values was statistical significant ($p<0.01$). The prosopic index of male students was significantly larger than that of female students ($p<0.05$) (Table 4).

DISCUSSION

In the current paper, the difference in craniofacial measurements between male and female university students in Japan was examined. Also, the researchers investigated the different type of head and face forms of Japanese university students and gender differentiation in craniofacial measurements and indices. Head and face dimensions of 1215 male and 832 female university students in Japan were measured. This paper showed that the mean cephalic index of Japanese adult male students was 85.9, which belonged to brachycephalic group. This result was in agreement with those of Rexhepi and Meka (2008) and Kanan et al. (2013). Rexhepi and Meka (2008) reported that the mean cephalic index of Albanican Kosovo was 83.5, which meant they belonged to brachycephalic group, also Kanan et al. (2013) found that the head form of South Gujarati people in India was brachycephalic. However, the current findings contradict those of North-eastern Nigerian adults, Mumbai in India and Odisha in India (Raji et al. 2010; Khair et al. 2013; Patro et al. 2014). Moreover, this current paper showed that each category of the

Table 4: Difference in mean values of different craniofacial measurements between male and female university students in Japan

Variable	*Sex*	*N*	*Mean*	*SD*	*SE*	*p-value*
HL (mm)	Male	1237	189.6	6.6	0.1	0.01
	Female	832	180.1	6.8	0.2	
HB (mm)	Male	1237	161.4	5.8	0.1	0.01
	Female	832	154.6	5.5	0.1	
HHt (mm)	Male	1237	133.4	7.2	0.2	0.01
	Female	832	129.5	6.2	0.2	
HC (cm)	Male	1237	57.2	1.4	0.0	0.01
	Female	832	55.2	1.4	0.0	
CI	Male	1237	85.9	1.4	0.1	0.01
	Female	832	85.2	4.5	0.1	
MFB (mm)	Male	1237	127.8	6.4	0.1	0.01
	Female	832	123.1	6.1	0.2	
BIZB (mm)	Male	1237	145.5	5.1	0.1	0.01
	Female	832	138.4	5.0	0.1	
BIGB (mm)	Male	1237	96.1	8.4	0.2	0.01
	Female	832	94.9	8.5	0.2	
MFHt (mm)	Male	1237	122.4	10.4	0.3	0.01
	Female	832	114.4	10.6	0.3	
PI	Male	1237	84.1	7.2	0.2	0.01
	Female	832	82.6	7.6	0.2	

cephalic index of male students was significantly higher than those of female students in Japan.

This paper revealed that the facial form of Japanese male students was mesoprosopic. The same result was also found in Haryanvi and Malaysian population (Kumar and Lone 2013; Shetti et al. 2011). However, the current finding disagreed with those of Yazd Kosova population (Tabatabaei et al. 2010; Rexhepi and Meka 2008). Also, the mean facial form of Japanese female students was mesoprosopic. Same result was also found in other papers (Raji et al. 2010; Kumar et al. 2013). However, the researchers' results again differed from other studies (Rexhepi and Meka 2008; Tabatabaei 2010; Shetti et al. 2011). Moreover, each category of the prosopic index of male students was significantly higher than those of female students.

In this paper, researchers observed that all craniofacial measurements of Japanese male university students were significantly higher than those of female students. These results were in agreement with those of Shah et al. (2015), who found that the mean value of head and face dimension of male students was significantly higher than those of female students in Gujarat, India. Moreover, Zhuang et al. (2004) also found significant facial anthropometric differences between genders.

The changes of head and face form over time of Japanese university students were investigated by Hossain et al. (2013) and Hossain et al. (2011). The possible factors were genetics, environmental factors, dietary protein, psychological and physiological stress, medical facilities and care, as well as climate. Moreover, several factors have also been identified in the change of the facial shape by many other authors (Abbie 1947; Bielicki and Welon 1964; Miller 1970; Beals 1972; Henneberg 1976; Crognier 1981). Some of these factors differently belongs to male and female, may be one of the major reasons for difference in craniofacial measurements between male and female university students. However, some researchers believe that the particular head form has been selected as a consequence of evolutionary forces (Bielicki and Welon 1964; Henneberg 1976).

CONCLUSION

In the present paper, craniofacial measurements were compared between Japanese adult male and female university students. Most of the Japanese adult students were of long and narrow face and round headed. There was a significant difference between male and female students for each category of the head and face forms. The significant difference between male and female students was also observed for all craniofacial variables that were considered important for sexual difference. Actual causes are still unidentified for differentiation in craniofacial morphology between males and females. Clearly, more research is required.

LIMITATIONS

The results of this paper need to be interpreted within the following limitations: firstly, the data was collected almost 15 years ago (from 1998 to 2001). Secondly, students from only two Japanese prefectures (Tokyo and Kyoto) were considered. Thirdly, only students who were studying in various universities and colleges were included. Fourthly, only the factor gender was considered in this paper. Future studies should include subjects from broader age groups and wider geographical regions within the country.

ACKNOWLEDGEMENT

The researchers would like to thank the Late Professor Fumio Ohtsuki for providing data and also like to thank Hossain et al. (2011) and Hossain et al. (2013) for contributing necessary information's for this paper.

REFERENCES

Abbie AA 1947. Head form and human evolution. *Journal of Anatomy,* 81(3): 233-258.

Beals KL 1972. Head form and climatic stress. *American Journal of Physical Anthropology,* 37: 85-92.

Bielicki T, Welon Z 1964. The operation of natural selection on human head form in an East European population. *Homo,* 15: 22-30.

Crognier E 1981. Climate and anthropometric variations in Europe and the Mediterranean area. *Annals of Human Biology,* 8: 99-107.

Dunn OJ, Clark VA 1974. *Applied Statistics: Analysis of Variance and Regression*. Toronto: John Wiley & Sons.

Golalipour MJ, Haidari K, Jahanshahi M, Frahani MR 2003. The shapes of head and face in normal male newborns in South-East of Caspian Sea (Iran-Gorgan). *Journal of the Anatomical Society of India,* 52: 28-31.

Henneberg M 1976. The influence of natural selection on brachycephalization in Poland. *Studies in Physical Anthropology,* 2: 3-19.

Hossain MG, Saw A, Ohtsuki F, Lestrel PE, Kamarul T 2011. Change in facial shape in two cohorts of Japanese adult female students twenty years apart. *Singapore Medical Journal,* 52: 818-823.

Hossain MG, Saw A, Alam R, Ohtsuki F, Kamarul T 2013. Multiple regression analysis of anthropometric measurements influencing the cephalic index of male Japanese university students. *Singapore Medical Journal,* 54(9): 516-520.

Jeyaseelann, Irfan M, Leng CW, Perera LRM, Palaniappan KK, Fatima Z 2016. Facial index among the ethnic races of Malaysian population - An anthropometric study. *IOSR Journal of Dental and Medical Sciences,* 15(12): 97-101.

Kanan U, Gupta DS, Andani R, Kubavat DM, Nagar SK, Varlekar P 2013. Study of cephalic index in South Gujarat. *International Journal of Recent Trends in Science and Technology,* 8: 87-89.

Khair S, Bhandari D, Wavhal S 2013. Study of cephalic index among the students of Mumbai region. *Indian Journal of Applied Research,* 3: 64-66.

Krishan K, Kanchan T 2012. Anthropometric and anthroposcopic analysis of face in forensic identification- some essential considerations. *Medico-Legal Update,* 12: 99-100.

Kumar M, Lone MM 2013. The study of facial index among Haryanvi adults. *International Journal of Science and Research,* 2: 51-53.

Maina MB, Mahdi O, Kalayi GG 2012. Craniofacial forms among three dominant ethnic groups of Gombe State, Nigeria. *International Journal of Morphology,* 30(1): 211-216.

Martin R, Saller K 1957. *Lehrbuch der Anthropologie.* Band 1. Stuttgart: Gustav Fisher.

Miller PS 1970. Secular changes among the Western Apache. *American Journal of Physical Anthropology,* 33: 197-206.

Patro S, Sahu R, Rath S 2014. Study of cephalic index in Southern Odisha population. *Journal of Medical and Dental Science,* 13: 41-44.

Raji JM, Garba SH, Numan AI, Waziri MA, Maina MB 2010. Morphological evaluation of head and face shapes in a North-Eastern Nigerian population. *Australian Journal of Basic and Applied Sciences,* 4: 38-41.

Rajlakshmi CH, Singh SM, Bidhumukhi TH, Singh CL 2001. Cephalic index of foetuses of Manipuri population - A baseline study. *Journal of the Anatomical Society of India,* 50(1): 13-16.

Rexhepi A, Meka V 2008. Cephalofacial morphological characteristics of Albanican Kosovo population. *International Journal of Morphology,* 26: 935-940.

Shah S, Khanal L, Koirala S, Bhattacharya SC 2015. The study of Prosopic index of 17-26 year old normal population in Eastern Nepal: Ethnic and gender variation. *Russian Open Medical Journal,* 4: 1-3.

Shah T, Thaker MB, Menon SK 2015. Assessment of cephalic and facial indices: A proof for ethnic and sexual dimorphism. *Journal of Forensic Science and Criminology,* 3: 1-11.

Shetti RV, Pai SR, Sneha GK, Gupta C, Chethan P, Soumya 2011. Study of prosopic (facial) index of Indian and Malaysian students. *International Journal of Morphology,* 29: 1018-1021.

Shinde SA, Sable RB, Patil AS 2016. Craniofacial anthropometric measurements of adult Indians in Angles class I malocclusion. *International Journal of Orthodontic Rehabilitation,* 7(4): 130-134.

Stevens J 1996. *Applied Multivariate Statistics for the Social Sciences*. Mahwah: LawrenceErlbaum Associates.

Sushma KK, Priyanka S, Kushal RK 2013. Comparative study of prosopic (facial) index of Sindhi community of Jodhpur district of Rajasthan and other communities and races. *International Journal of Anatomy and Research,* 1: 171-173.

Tabatabaei Z, Yasaei S, Ardakani MD, Said AM 2010. Assignment and compression of facial index and modified smile index (MSI). *Iranian Journal of Orthodontics,* 5: 70-76.

William P, Dyson M, Dussaak JE, Bannister LH, Berry MM, Collins P, Ferguson MWJ 1995. *Gray's Anatomy.* In: *Skeletal System*. 38th Edition. London: Elbs with Churchil Livingston.

Zhuang Z, Guan J, Hsaio H 2004. Evaluating the representativeness of the LANL respirator fit test panels for the current U.S. civilian workers. *Journal of the International Society for Respiratory Protection,* 21: 83-93.

Paper received for publication on September 2016
Paper accepted for publication on November 2017