Facial Index Among the Ethnic Races of Malaysian Population - An Anthropometric Study

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Abstract: *Anthropometric measurement is useful in application of reconstructive surgery, oral surgery and identification in forensic science .There are various factors that affect facial index, which includes age, gender and ethnic race. The present study conducted is to identify the facial index among the different ethnic races of Malaysian population - Malay, Chinese and Indian.Measurements of facial height and facial width were obtained using Verniercaliper. A total number of565 students between the ages of 20 – 25 years, 179 Malays, 215 Chinese and 171 Indians were used in the present study. Facial index calculated from the measurements made.*
There is a statistically significant difference in facial index among males and females of Indian race (p=0.032). In all the races, females have a higher facial index than males except for Indian race, where males have a higher facial index than females. Indian race (in males and females) recorded a highest facial index, followed by Malays and Chinese. The result is statistically significant with p=0.016. The Anthropometric measurements can be of importance to Anthropologists and its application in forensic studies.
Keywords: *Facial height, Facial width, Facial index, Forensic anthropometry.*

I. Introduction

Anthropometry is defined as the measurement of size and body proportion of living and dead human beings and also skeletons, as 'Anthropos' means man and 'metry' means to measure. There are wide range of applications of anthropometry in health care and manufacturing industries including reconstructive surgery, oral surgery and identification of human beings in forensic studies.Anthropometry particularly the face and head measurement is essential in design industry for manufacture of hats, helmets and goggle [1-3].

Anthropometric measurements can be used together with cephalometry, computed tomography (CT) and magnetic resonance imaging for a patient going through plastic surgery, so as to enable an accurate measurement of body parts and lower the margin of error during surgery [4]. Plastic surgeons measure the face to quantitatively understand the facial changes requested by the patient in the hope of improving facial appearance [5]. Population variation for the facial measurement can also be estimated [5].There are many factors that affect the facial index of an individual besides gender and race. These includes age, ethnic, climate, ecological, geographical, socio-economic, biological, nutritional and genetic factors [6].According to Kumar et al, by identifying the facial index of an individual, the inheritable traits that are passed on from the parents to their offspring[7] can be understood. This is important for karyotyping and record purposes.

Facial measurement is useful for physicians to diagnose normal and abnormal growth in a person [8], for example an individual that is malnourished will have less facial width than one who is well nourished. Facial index measurement is also important to diagnose congenital abnormalities, facial disorders due to hormonaldisordersandmorphologicalchangesduetotraumain a patient. Due to the number of factors that produce differences in skeletal proportion in different geographical areas that can influence skeletal development, it is better to have ways of assigning quantitative expressions to the variations which such traits exhibit [9].

Each race has varied facial index due to the influence of gene pool and anthropometry is essential to differentiate between a pure race and amixed race [10,11]. Despite relevant anthropometry studies, focussing on different body parts other than the craniofacial measurements for both sexes have been reported [12].Craniofacial studies have been reported by Umar et al, Heideri et al, Vughosh and Malik, Jahanshahi et al, Ngeow and Aljunid and also Raji et al [13-17]. The purpose of calculating facial index is to identify individual face shape. By calculating the facial index, one can identify the face shape. When the facial index is <79.9, the individual is said to have hypereuriprosopic face shape,between 80-84.9, it is euryprosopic face shape and between 85-89.9, it is mesoprosopic face shape. Leptoprosopic face is an index of between 90-94.9 and hyperleptoprosopic face is >95 [18]. Certain face types favour the nasal breathing mode thereby calculating the facial index may help in diagnosing an increase in susceptibility to obstructive sleep apnea [19].

Based on anthropometric studies, European tend to have narrower face and retracted zygomatic arches whereas Asian has wider but flatter faces [9]. A research of anthropometric studies is also carried out to determine only the facial height proportions among different endogamous communities in Nepal to compare the facial growth patterns among different genders and age group [20].It can be concluded that the science of comparative racial anthropometry has shown that there is a difference between body proportions of different races [20].

II. Materials and methods

This study was conducted onrandomly selected 565 students inclusive of 179 Malays (75 males, 104 females), 215 Chinese (106 males, 109 females) and 171 Indians (67 males, 104 females) between the age group of 20 -25 years. Measurements were taken at the Department of Anatomy, Faculty of Medicine, SEGi University, Kota Damansara Campus, Malaysia.The exclusion criteria were the students who have permanent impaired nasal obstruction, or have received orthodontic treatment, students who have complex abnormalities in the craniofacial such as cleft lip, craniofacial fracture, or students who have undergone facial surgery due to cosmetic reasons or traumatic accidents.

The anatomical landmarks used are
a. Nasion(n):the point on the root of the nose where the midsagittal plane cuts the nasofrontal suture.
b. Gnathion (Gn): the lowest point of mandible where the lower margin of the lower jaw is intersected by the midsagittal plane.
c. Zygion (Zn): the most lateral point on the zygomatic arch.

The measurement process was explained to each subject and written permission was obtained prior to measurement. The measurements were repeated three times and the mean value of the measurements was taken for further analysis.

The facial landmarks were used to determine facial index by measuring the face length and breadth using Verniercaliper. Morphological facial height was measured with Verniercaliper with scale from nasion (n) to gnathion (Gn). Face width was measured as the straight distance between the right and left zygion (Zy) that is the bizygomatic breadth.

Facial index calculated using the formula -Facial index (Prosopic index) $= \frac{\text{Facial length}}{\text{Facial width}} \times 100$.

The independent variable of this study is the ethnic group of the participants (Chinese, Malay and Indian) and the dependent variable is the facial index of the participants. Statistical analyses were done by using SPSS version 22.0 and Independent t-test was used to identify significance for facial index of males and females and between races whereas ANOVA test was used to identify significance of facial index in the three ethnic groups.

III. Results

Females have a higher facial index than males for all races (Table 1). The males have a higher facial index than females in Indians, and is statistically significant (p=0.032). Indians (both sexes) recorded a highest facial index, followed by Malays and Chinese. The result is statistically significant (p=0.016) Fig. 1. Chinese and Indians have a significant facial index (p =0.004, Table 2)

In all races, males have a significant higher vertical and transverse facial length than females (p<0.05). Chinese male has the highest vertical and transverse facial length compared to other races and compared to Chinese females (Fig 2 and 3). Among females, Malays have the longest face with mean vertical measurement of 10.64cm±0.94 while Chinese has the widest face 10.75cm±0.87 (Fig 2 and 3).

For the Malay population, the mean and standard deviation of facial index are 99.53±10.19 and 101.68±10.11 for male and female respectively. However, this parameter showed no significant difference between male and female Malay population with (p=0.163). Facial index of both male and female Chinese population recorded the lowest figure which is 99.13±8.77 for male, while for female is 99.15±9.95.There is also no significance difference for this parameter between Chinese male and female (p=0.982).

The mean and standard deviation of Indian females is 100.59±8.81, for males is 104.35±12.28. Indians are the only ethnic group with significant difference of facial index between males and females (p=0.032). Indian male has the highest mean facial index compared to Chinese male 99.13±8.77 and Malay male 99.53±10.19. Among females, Malays recorded the highest mean facial index compared to Indians and Chinese.

Table 1. The craniofacial parameter according to gender and ethnic groups

	Malay		Chinese		Indian	
Parameters	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
VLF (mean±SD)	10.92±0.80	10.64±0.94	11.33±0.65	10.60±0.87	10.84±0.71	10.37±0.89
p-value	0.037*		0.000*		0.000*	
TFL (mean±SD)	11.07±1.02	10.47±0.75	11.50±1.04	10.75±0.87	10.50±1.13	10.35±0.86
p-value	0.000*		0.000*		0.333	
FI (mean±SD)	99.53±10.19	101.68±10.11	99.13±8.77	99.15±9.95	104.35±12.28	100.59±8.81
p-value	0.163		0.982		0.032*	

*Statistically significant difference (p<0.05) using independent t-test.
VLF: Vertical length of face, TLF: Transverse length of face, FI: Facial Index.

Table 2: The mean facial index according to race

Parameters	Malay	Chinese	Indian
Overall FI(both sexes)	100.78±10.17	99.14±9.37	102.06±10.44
p-value	0.097*		
p-value		0.004*	
p-value(M and F)	0.246*		0.246*
p-value		0.016**	

*Denotes Independent t-test, ** Denotes ANOVA test,
M: Male, F: Female,VLF: Vertical length of face,TLF: Transverse length of face, FI: Facial Index.

Figure1: Bar chart showing mean facial index of each gender according to race
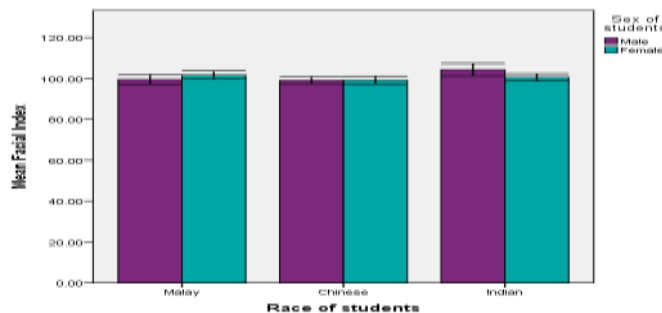
For Malay male vs female
P-value=0.163*, no statistically significant difference of mean facial index between Malay male and female.
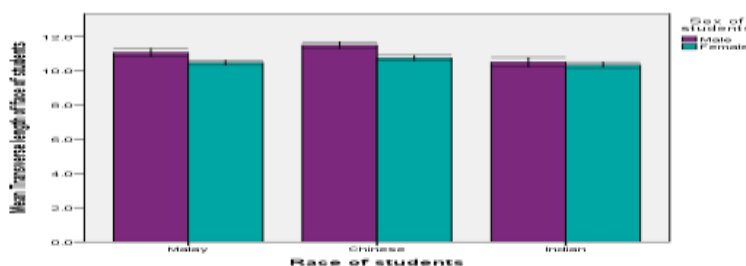For Chinese male vs female
P-value=0.982*, no statistically significant difference of mean facial index between Chinese male and female.
For Indian male vs female
P-value=0.032*, statistically significant difference of mean facial index between Indian male and female.

Figure 2: Bar chart showing mean facial width of each gender according to race.

For Malay male vs female
P-value=0.000*, statistically significant difference of mean transverse facial length between Malay male and female.
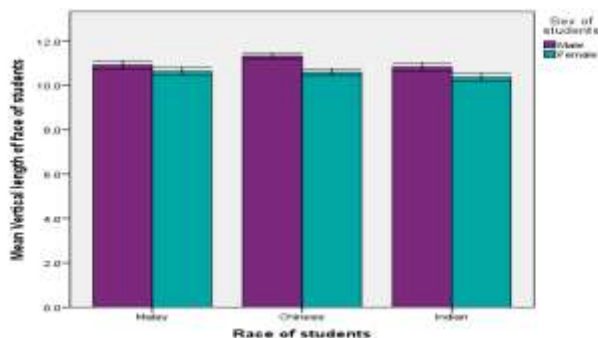For Chinese male vs female

P-value=0.000*, statistically significant difference of mean transverse facial length between Chinese male and female.
For Indian male vs female
P-value=0.333*, no statistically significant difference of mean transverse facial length between Indian male and female.
Figure 3: Bar chart showing mean facial length of gender according to race.

For Malay male vs female
P-value=0.037*, statistically significant difference of mean vertical facial length between Malay male and female.
For Chinese male vs female
P-value=0.000*, statistically significant difference of mean vertical facial length between Chinese male and female.
For Indian male vs female
P-value=0.000*, statistically significant difference of mean vertical facial length between Indian male and female.

IV. Discussion

The Anthropometric measurements of the face for three main races in Malaysia which are Malay, Chinese and Indian which include facial height, facial width and facial index. There is a correlation between race and facial index, facial width and facial height of a person. In the present study, there is no statistically significance difference for the sexual dimorphism of facial index for both Malay and Chinese students. However, Indian males and females showed statistically significant difference (p=0.032) in facial index with males having a mean facial index of (104.35±12.28) while females was (100.59±8.81). Indian males showed a higher mean facial index (104.35±12.28) than females (100.59±8.81).Our present findings are in line with the previous findings in Gujarat region by Shah et al(2012). proving a highly significant difference in facial index between males and females and also a higher mean facial index value for Indian males (89.96) than females (87.06) [5]. Our findings also supports another study,to determine the facial index and other facial parameters among North and south Indians people[12].However, the study carried out by Vaishali et al (2011) about facial index of Indian and Malaysian students did not match with our findings, instead concluded that there was no significant difference of facial index among Indian males and females[7].

In a study by Kurnia et al, Chinese men showed a higher mean facial index than Chinese women. The mean facial index for Chinese men was 89.60 while for women it was 86.67 [19] which contradicted with our present study and the mean value recorded in present study was also higher in both females (99.15) and males (99.13). Our results showed Indians (both sexes together) had a higher mean facial index (102.06) than Malays (100.78) and Chinese (99.14) which was similar with the findings of Vaishali et al [7].When the facial index between two races were compared, there was significantdifferencefor Indians and Chinese race (p=0.004). The mean facial index obtained in our present study for Indians (104.35 in males and 100.59 in females), Malays (99.53 in males and 101.53 in females) and Chinese (99.13 in males and 99.15 in females), arehigher when compared withVaishali et al; for Indians (87.19 in males and 86.75 in females) andMalaysians(85.72 in males and 87.71 in females) [7].Jeremic et al [6] and Jahanshahi et al [14], reported a higher mean facial index compared to our present study.

V. Conclusion

There is statistically significant sexual dimorphism of mean facial index among Indians (p=0.032). The mean facial index of Malay and Chinese students was higher in females than males but among Indians male

students showed a higher mean facial index than female students. Overall, the mean facial index for both sexes is highest among Indian students, followed by Malays then Chinese (p=0.016). Also, Chinese and Indians are the only subgroups showing significant difference of facial index (p=0.004). Anthropometric measurements are important for applications in forensic studies, plastic surgery and also in manufacturing of hats and helmets. Hence it is important that more studies may be conducted to determine the facial index of the three main ethnic groups in Malaysia.

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