Research Article

The Similarity Between Chinese-Indonesian, Sundanese and Bataknese Based on Facial and Nasal Index

Alberta Karolina,[1] Andri A. Rusman,[2] Yoni F. Syukriani[1*]

**[1]Department of Forensic and Legal Medicine, Faculty of Medicine, Universitas Padjadjaran –
Dr. Hasan Sadikin Hospital, Bandung, Indonesia**
[2]Department of Forensic and Legal Medicine, Faculty of Medicine, Jendral Ahmad Yani University, Cimahi, Indonesia

Abstract

Identification plays a vital role in forensic medicine to determine personal identity. There is a possibility that facial index (FI) and nasal index (NI) are different between Chinese-Indonesian, Sundanese, and Bataknese, three important ethnic groups in Indonesia. The study aim is to determine the similarity between the three ethnicities based on FI and NI. A cross-sectional study was conducted in Bandung City in May-July 2018. Subjects were collected randomly from 21-50 years old adults, 64 people from each group. Morphometric analysis of the face and nose was conducted to produce FI and NI. Results showed that all groups were predominantly hyperleptoprosop, having a very long-narrow face (FI $\geq$ 93). All males and Sundanese females are predominantly hyperleptorrhine, having a very long-narrow nose (NI 40-55). The Chinese-Indonesian female is predominantly chamaerrhine, having a short-broad nose (NI 85-99.9). The Bataknese females are predominantly hyperchamaerrhine, having a very short-broad nose (NI $\geq$ 58). The hierarchical clustering analysis showed a close similarity between Chinese-Indonesian and Sundanese groups compared they are with Bataknese. This finding is consistent with the South-East Asian migration theory. The result could be used to support comparative identification in situations when forensic anthropology is a critical choice to estimate ethnic affiliation.
Keywords: *forensic identification, cephalometric index, facial index, index nasalis, hierarchical clustering.*

Kemiripan Antara Suku Tionghoa-Indonesia, Sunda, serta Batak Berdasarkan Indeks Fasial dan Nasal

Abstrak

Identifikasi berperan penting dalam kedokteran forensik untuk menentukan identitas personal. Ada kemungkinan perbedaan indeks wajah (FI) dan indeks hidung (NI) antar kelompok Cina-Indonesia, Sunda, dan Batak, sebagai tiga kelompok etnis penting di Indonesia. Penelitian ini bertujuan menentukan kemiripan di antara ketiga kelompok tersebut berdasarkan FI dan NI. Penelitian cross-sectional dilakukan di Kota Bandung bulan Mei-Juli 2018. Subjek diambil secara acak dari orang dewasa (21-50 tahun), 64 orang dari setiap kelompok. Analisis morfometri dilakukan untuk menghasilkan FI dan NI. Hasil menunjukkan seluruh populasi umumnya hyperleptoprosop, memiliki wajah sangat panjang dan sempit (FI $\geq$ 93). Perempuan Sunda dan seluruh laki-laki umumnya hyperleptorrhine, yaitu hidung sempit (NI 40-55). Perempuan Cina-Indonesia umumnya chamaerrhine, yaitu hidung lebar dan pendek (NI 85-99,9). Perempuan Batak umumnya hyperchamaerrhine, yaitu hidung sangat lebar dan pendek (NI $\geq$ 58). Analisis kluster hirarki menunjukkan kelompok Tionghoa-Indonesia memiliki kemiripan lebih dekat dengan kelompok Sunda dibandingkan dengan kelompok Batak. Hasil ini konsisten dengan teori migrasi di Asia Tenggara. Hasil ini dapat digunakan untuk identifikasi komparatif jenazah korban dalam situasi yang membutuhkan metode antropologi forensik untuk estimasi kelompok etnis.
Kata kunci: *identifikasi forensik, indeks sefalometrik, indeks wajah, indeks hidung, klaster hirarki.*

Introduction

Identification has a vital role in forensic medicine as an effort to assist investigators in determining personal identity, in daily forensic cases or humanitarian matters. It plays roles, namely, to help find and reveal the personal identity of an unknown person or in mass fatalities when time, facilities, and human resources are limited.[1-3]

Forensic identification method can be divided into comparative and reconstructive identification. Reconstructive identification is a method of identification by reconstructing examination results data into estimates of gender, age, race, height, shape and specific characteristics of the body. Comparative identification is a method of identification by comparing the characteristics of an unknown person with missing person data or database. Reconstructive forensic identification is used as an alternative if the requirements for comparative identification cannot be fulfilled, that is when complete and accurate data are not available.[2,3]

Physical anthropologists constructed several indexes to see human anatomy differences more thoroughly in reconstructive forensic identification. The cephalometric index consists of the head index (cephalic index), face (facial index/FI), forehead (frontoparietal index), and nose (nasal index/NI). The FI is the ratio of face length to width, whereas the NI is the ratio of nose width to length.[3-6]

Indonesian population consist of 633 ethnic groups, which have different characters, history, ideology, and religion, including several descendants of the world's main populations, such as Chinese, Arabs, Indians, and Caucasian.[7] The Bataknese ethnic group is part of the Proto-Malay group that historically occupied Nothern-Sumatra region, although nowadays many of them settled in Java Island and many parts of Indonesia. The original descendants of the Deutro Malay race are the Malays, Acehnese, Minangkabau, Lampung, Javanese, Sundanese, Madurese, Bugis, Manado, Minahasa, and others. Most of the Sundanese occupies West Java region.[8,9]Top of Form

Research on Sundanese and Bataknese ethnic groups by Rivani in 2017, which was limited to cephalic index measurements, showed results that Sundanese ethnicity, both male and female, has hyperbrachicephalic (an extreme degree of brachycephaly, with a cephalic index of over 85), while both male and female of Bataknese ethnicity are brachycephalic (having a short, broad head with a cephalic index over 80).[10] In West Java,

Sundanese is more dominant than the Bataknese and Chinese-Indonesian ethnicities, so historically it is interesting to find a relationship based on an index. Here we report a study of the FI and NI between Chinese-Indonesian, Sundanese, and Bataknese.

Methods

The subjects were collected randomly from communities of Bataknese people, namely students of the Faculty of Law, Universitas Padjadjaran and Bataknese Protestant Church congregations. Whereas for Chinese-Indonesian, the subjects was taken from students of the Faculty of Medicine, Maranatha Christian University. For Sundanese, the subjects were collected from around Bandung, where Sundanese are native. Data collection was conducted between May and July 2018.

The inclusion criteria are young adults (21 to 50 years), Chinese-Indonesian (confirmation of lineage through the ethnicity at least up to two generations). Exclusion criteria are having a disease that causes disturbances in facial bone growth (down syndrome, labioschizis, palatoschizis, labiopalatoschizis, microcephaly and macrocephaly), or have experienced a craniofacial injury or surgery. Drop out criteria are those who at the time of measurement were found to have a very extreme height/width of the face or nose, and those who wish to withdraw themselves to become subjects.[6,11]

The study design is cross-sectional and the morphometric analysis was conducted by measuring the length and width of the face, the length and width of the nose as dependent variables, and then the data were calculated to produce FI and NI. The independent variables are gender and ethnicity.[3,4,12]

The univariate analysis presented the data of age, ethnicity, face length, facial width, nose length, nose width, FI, and NI, in the form of calculating the average value and standard deviation (SD). The subjects data were categorized based on the classification of Martin and Saller.[3,12] Bivariate analysis was conducted after the data were categorized. One-sample Kolmogorov Smirnov analysis was performed to check the distribution, followed with independent t-test or Mann Whitney, depends on the normality. The results were then analyzed using multivariate approach by hierarchical clustering to demonstrate the distance between the Chinese-Indonesian, Sundanese, and Bataknese ethnic groups with gender factor as a consideration. The first hierarchical clustering was

performed with FI and NI as input, whereas prior to the second clustering the FI and NI data were classified using Martin and Saller classification then the results were input to hierarchical clustering software. The results were presented in dendrogram. The hierarchical clustering was using SPSS.[4,13-15]

The protocol of this study has been reviewed by and granted ethical clearance from the Komisi Etik Penelitian Kesehatan Universitas Padjadjaran No. 525/UN6.KEP/EC/2018.

Results

Subjects collected are 64 people from each ethnic group (the total is 192), each group comprised of 32 males and 32 females. Normality testing demonstrates the normality of facial width and FI of the Chinese-Indonesian (male and female); nose width of the Sundanese female; facial width of Bataknese male, and the nose width of Bataknese

female, while the rest were not normally distributed.

The bivariate analysis showed that the FI and NI of Chinese-Indonesian male are greater than those of Sundanese male, although it was not significant ($p > 0.05$) to Sundanese male. The NI of Sundanese female is significantly greater than it of the Chinese-Indonesian female, while for the FI is not significant (Table 1).

The FI and NI of Bataknese male are greater than those of Chinese-Indonesian male, although they are not significant whereas the FI of Chinese-Indonesian female is greater than those of Bataknese female; however, it is not significant. On the contrary, the NI of Bataknese female is significantly greater than it is in Chinese-Indonesian female.

The FI and NI of Bataknese male are greater than those of Sundanese male, although they are not significant. The FI of Sundanese female is greater than that of Bataknese female, while the NI is *vice versa*, and both are not significant.

Table 1. The mean of Facial Index and Nose Index between Sundanese and Chinese-Indonesian, Bataknese and Chinese-Indonesian, and between Bataknese and Sundanese

Indexes	Male		p-value	Female		p-value
	Sundanese	Chinese- Indonesian		Sundanese	Chinese- Indonesian	
FI	100.43	102.17	0.075*	103.89	104.26	0.619*
NI	82.15	80.89	0.571	81.72	81.66	0.005
	Bataknese	Chinese- Indonesian		Bataknese	Chinese- Indonesian	
FI	102.51	102.17	0.682*	101.54	104.26	0.177*
NI	85.51	80.89	0.736	85.49	81.66	0.004
	Sundanese	Bataknese		Sundanese	Bataknese	
FI	100.43	102.51	0.987	103.89	101.54	0.826*
NI	82.15	85.51	0.397	81.72	85.49	0.629*

*Mean difference test using Mann Whitney U-Test

Based on the Martin and Saller classification of facial shape, the Chinese-Indonesian, Sundanese and Bataknese ethnic groups (both male and female) were hyperleptoprosop (having a very long narrow face with a FI of 93 and over on the face of living person and of 95 and over on the skull). Based on the nasal shape, the male from the three groups and the Sundanese female group are categorized

as hyperleptorrhine (having a very long narrow nose with a NI of 40 to 55), the Chinese-Indonesian female group is categorized as chamaerrhine (having a short-broad nose with a NI of 51-57.9 for a skull, and 85-99.9 for a person). In contrast, the Bataknese female group is hyperchamaerrhine (having a short and broad nose with a NI of 58 or over). All result is presented in Table 2.

Table 2. Facial Index and Nasal Index According to Martin and Saller Classification of the Chinese-Indonesian, Sundanese, and Bataknese Ethnic Group

Shape	Chinese-Indonesia		Sundanese		Bataknese	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
Facial Index						
Hypereuryprosop (H1)	3.125	0	0	0	0	0
Euryprosop (E)	0	0	0	0	3.12	0
Mesoprosop (M)	0	0	3.125	0	0	0
Leptoprosop (L)	6.25	0	6.25	3.125	0	0
Hyperleptoprosop (H2)	90.625	100	90.625	96.88	96.88	100
Nose Index						
Hyperleptorrhine (H1)	43.75	21.875	46.87	37.5	25	21.88
Leptorrhine (L)	18.75	12.5	18.75	15.6	15.62	6.25
Mesorrhine (M)	9.375	28.125	18.75	15.6	21.88	25
Chamaerrhine (C)	25	34.375	6.25	12.5	15.62	15.62
Hyperchamaerrhine (H2)	3.125	3.125	9.38	18.8	21.88	31.25

Note: the data given in bold is the highest percentage in the data set

The result of multivariate analysis using hierarchical clustering is shown in the form of dendrograms. Figure 1(a) demonstrates the similarity (concurrently the distance) between the Chinese-Indonesian, Sundanese, and Bataknese ethnic groups based on FI and NI, with gender factor as a consideration, but without grouping the data into Martin and Saller classification. It shows the data are divided into male and female groups, and each group shows the same phenomenon of close similarity between Sundanese and Chinese-Indonesian than with Bataknese group.

Figure 1(b) demonstrates the similarity between the three ethnic groups based on Martin and Saller classification (Table 2), with gender as a consideration. It shows that female Sundanese group, male Bataknese group, female Bataknese group, and female Chinese-Indonesian group are in the same cluster, apart from the male Chinese-Indonesian and male Sundanese which form a separate cluster.
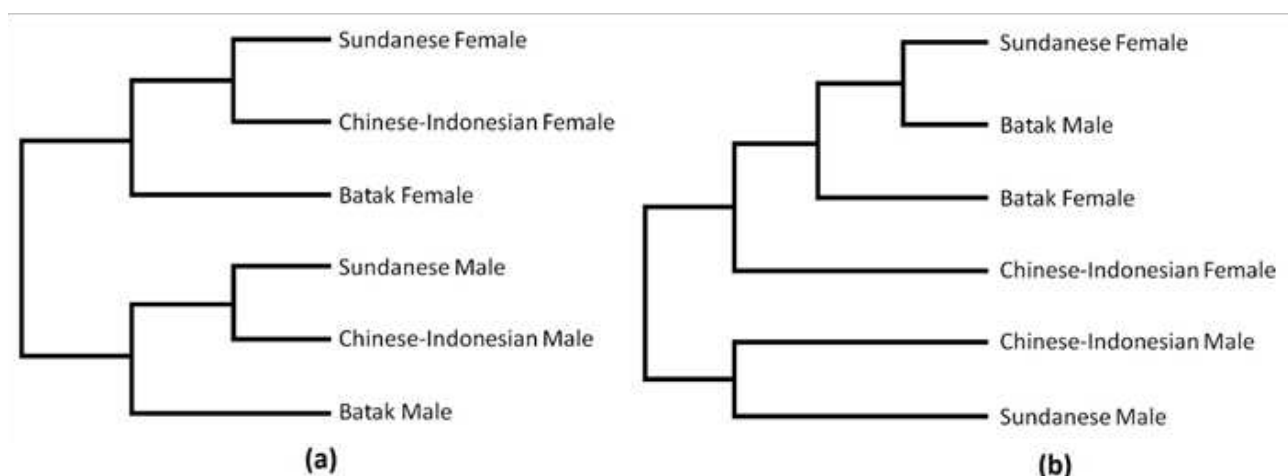

Figure 1. The relationship between Chinese-Indonesian, Sundanese, and Bataknese Ethnic Groups Based on Facial Index and Nasal Index

(a) The dendrogram resulted from FI and NI analysis, without classifying the data according to Martin and Saller, shows close similarity between Sundanese and Chinese-Indonesian, than they are with Bataknese group, both the male and female group; (b) The dendrogram resulted from FI and

NI analysis with classifying the data according to Martin and Saller, shows the Sundanese female, Bataknese male and female, and Chinese Indonesian female were placed in one cluster, while the Chinese-Indonesian male and Sundanese male group falls into a different cluster.

Discussion

Chinese ethnicity in Indonesia (Chinese-Indonesian) is the descendants of Chinese who migrated to Indonesia and then settled and had offspring with fellow Chinese or another native ethnic group in Indonesia.[17] Chinese ethnicity consists of a large number of groups, are understood to migrate to the Indonesian archipelago (Chinese-Indonesian) in several influxes. The most studied are migration around 3000-1500 BC, 1500-1000 BC, and 18-19th centuries, which through mixing with the existing natives resulting in the ethnic group of Proto-Malay (Old-Malay), Deutro-Malay (New-Malay), and Chinese-Indonesian.[5,8,9,16,17] Together with smaller groups of migration from Western Asian (Arabic) and South Asian (Indian), they settled down in the tropics and adapted to the local climate and mixed with indigenous people priorly occupied the archipelago. It resulted in the ethnic group of Malay or Malay-Mongoloid (Southeast Asian group). They spread in Southeast Asia, Oceania, and on the island of Madagascar off the coast of Africa.[18,19] Currently, they settled in almost all parts of the Indonesian archipelago, particularly in Java Island as the most populated island.[8] This theory has been challenged from time to time, but as it is still widely used, this paper will use it as an important assumption.

Chinese-Indonesian has anatomical features of oval and narrow head, narrow face, upright and slightly curved forehead, smooth eyelids without eye folds (Mongolian fold), slanted eyes with brown-black eyeballs, flat nose roots, higher nose trunk, wide nose wings, pointed chin shape, white skin. Those anatomical characters are different when compared to the Western Asian and South Asian (Malay) ethnic groups.[20-22]

The Proto-Malay group was believed as the ancestor of the Indonesian people who first came to Indonesia around 1500-3000 BC, originated from Yunan (Southern China). The Malay group tend to have sloping chin lines, even Proto-Malay or Bataknese ethnic group, have a chin that is box-shaped and a strong and firm jawbone.[1,5] Proto-Malays have straight hair, brownish-yellow skin, and slanted eyes. Most of their descendants are currently inhabit the central and eastern Indonesia, such as Dayak, Toraja, Sasak, Rejang, and Papua. In the western of Indonesia, they populate Sumatra Island as Bataknese, Mentawai, and Nias. The Deutro-Malay group came to Indonesia in the second wave of migration from China around 1500 BC originated from the Indo-North Chinese, comparable with population groups of Taiwan, Cambodia, Laos, Vietnam, and the Philipines. In the majority, they settled in the western and central part of the Indonesian archipelago.[21,23,24]

There are other studies on Indonesian ethnic groups using cephalometric variations. Irsa et al[25] analyzed ethnic groups in West Sumatra, using Unweighted Pair-Group Method with Arithmetic Average (UPGMA). Only they first classified the FI and NI data in accord with Martin and Saller. A study of the Bataknese group living in Jember found that they are predominantly hypereuryprosop (64%), compared to the Javanese (a group close to the Sundanese group) is predominantly hypereuryprosop (50%). An NI study using Torajan group as another ethnic group of Proto-Malay showed that they are predominantly mesorrhine,[24] compared to our study that shows the Bataknese as predominantly hyperchamaerrhine, particularly the female.

This research was conducted in the city of Bandung and when compared with previous research conducted in a different place with the same ethnicity, gave different results. For example, the Bataknese male in Bandung City is predominantly hyperleptoprosop (96.88%) and the Bataknese female is all hyperleptoprosop (have a higher or narrower face type). In contrast, the results of Bataknese ethnicity in Java Island are predominantly hypereury- prosop, followed with mesoprosop, and euryprosop (the face is shorter or wider).[18] This phenomenon should be studied further for evolutionary biology to search for the answer of whether this phenomenon was caused by anatomical change or only due to different group of Bataknese migrated to different places in Java.

The result of NI calculation shows there is no predominant nose shape belongs to a certain ethnic group in this study. The proportion is distributed to five facial shapes. The Sundanese male and Chinese-Indonesian male groups have 46.87% and 43.75% hyperleptorrhine shape, whereas the same shape in Bataknese male is 25%. In women, the nose shape is also distributed to the five nose shapes with different predominant shape among them. The Sundanese female group is 37.5%

hyperleptorrhine (similar to the Sundanese male), while the Chinese-Indonesian female group is 34.4% chamaerrhine and Bataknese female group is 31.25% hyperchamaerrhine. The latter two are different from their male counterpart.

The result of the hierarchical clustering shows an interesting phenomenon. The Bataknese ethnic group, as one of the prominent groups of Proto-Malay, has different feature compared to the Sundanese as a part of Deutro-Malay group and the Chinese-Indonesian [Figure 1 (a)]. This phenomenon corroborates the latter two migration influxes from China to the archipelago resulting Deutro-Malay group, that is the Chinese-Indonesian shares the same ancestor with the Sundanese recently. On the other hand, the dendrogram of Figure 1 (b) showed a different grouping, which inconsistent with the migration theory. There is a possibility that the classification according to Martin and Saller used to form the dendrogram, had caused some people with similar FI or NI were distributed into different classification. As a result, the dendrogram of Figure 1 (b) showed a somewhat random cluster, compared to Figure 1 (a). Although Martin and Saller classification is still widely used to classify facial and nose shape, nevertheless prudence is required when scientists are trying to calculate the relationship among ethnic groups. The digital hierarchical clustering approach enables scientists to perform a thorough analysis of large sum of data.

We observed that there are no significant differences between the Chinese-Indonesian and Sundanese ethnic groups, suggesting close similarity between them and indicating that both share recent common ancestor, compared to their relationship with the Bataknese. This finding is consistent with the migration theory of South East Asian population. Hierarchical clustering analysis using data that have been classified according to Martin and Saller produced a result that is inconsistent with the migration theory. Although we still considered the classification method as a robust tool in physical anthropology, we suggest that to minimize bias in determining the relationship between ethnic groups it is better to use data that has not been classified into certain grouping. Further studies should be conducted to validate hierarchical clustering as a tool to determine the relationship between ethnic groups. Research on morphometric indexes is vital in developing database for forensic identification purposes, mainly to estimate the ethnic affiliation of unknown person or skeletal remains. We suggest to increase the collection of morphometric measurements from other ethnic groups in Indonesia, both for forensic identification and anthropology studies.

Conclusion

The Chinese-Indonesian has close similarity with the Sundanese in comparison with Bataknese. From the forensic perspective, the result could be used to support comparative identification in mass fatalities or other situation when forensic anthropology is a critical choice to estimate ethnic affiliation.

Acknowledgement

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