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Comparative Study of Cephalometric Traits in Various Ethnic Groups in Indonesia

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ABSTRACT

Anthropometry has been used for many scientific and applied problems, such as growth, evolution, and applications to forensic identifications. The aim of this study was to determine whether the samples could be significantly differentiated from each other from a set of cephalometric data. The comparison of group could be used in forensics for the determination of ethnic identity and/or sex. The samples consisted of 3822 individuals from Alor, Atoni, Barawahing, Marai, Tetum, Java, Kabir, Lemma, Manggarai, Middle Pantar, Ngada, East Alor and Palue. The variables were g-op, eu-eu, ft-ft, zy-zy, go-go, al-al, n-sn, and n-gn. "Classificatory discriminant analysis" was used to differentiate the groups. "Mahalanobis distance" determined the distance between the samples. The Java sample had the farthest Mahalanobis distance from the other samples. Correct classification could be done in 17.7%-83.4% of males, and 18.4%-86.2% of females within each group. More than 40% were correctly classified in 5 samples of males, and 8 samples of females. In all individuals, 84% females and 86% males were classified to the correct sex.

Key words: cephalometry, Javanese, Indonesian central islanders, affinity

INTRODUCTION

The interactions between biological and social factors can be found in many examples of the practical use of anthropometric data. Anthropometry is appropriate and pliable to many scientific and applied problems, such as growth, evolution, human factors in design of clothing and equipments, the aviation and automotive industries in improving seating accommodation, industrial designers, architects, engineers, and insurance companies, objective signs of physical fitness or illness by medical professionals, biologists and nutritionists; and applications to forensic identifications (Hertzberg, 1968; Lasker, 1994). Most recent research in cephalometric are related to orthodontics and dentistry (such as Chen *et al.*, 2000; Bean *et al.*, 2002; Edler, Wertheim, and Greenhill, 2002; Grabowski *et al.*, 2003; Sondang *et al.*, 2003; Ochoa and Nanda, 2004; Geophine, Siregar and Krisnawati, 2006; Heryumani, 2006).

This research looked at the differences between the sexes and between several groups of populations. Generally males are bigger and have a longer period of growth (Brodie, 1963 *cit.* Iyer and Lutz, 1966). The study of Iyer and Lutz (1966) concerning the Indian and English facial profiles using the generalized T^2 test and Discriminatory Analysis brought out the differences between the two populations very convincingly. With nearly 80% accuracy it was possible to segregate the individuals to the correct sex and to differentiate them into two groups.

The differences between sexes in cephalometric measurements have also been studied by Harvold and Hatton (1961), who found that there were differences in profiles between males and females. Bambha (1961) found that girls had smaller value of measurements and slower pace of growth, and the difference was statistically significant. Male children had more convex faces than female children (Baum, 1951). While some variations among individuals are to be expected--as in their basic facial pattern--variations cannot be expected as a simple consistent differences among the groups or sexes (Iyer and Lutz, 1966).

Relethford (1994) did a study on the craniometric variation among the modern human populations. He concluded that the cephalometric was affected by natural selection so that there was variation among geographic region. Sokal and collegues (1987) classified European skulls from three time periods using craniometry. They found significant associations between populations and language, geography and time period.

The main purpose of this research is not to determine the roles of genetic and environment to the cephalofacial morphology, not how much each contributes to the size and shape of the cephalofacial morphology, but to look at the different morphology between different sample populations in different regions and between sexes in different sample populations.

Although there were several studies in anthropometric measurements in Indonesia, there are no recent studies in comparison of living human cranial measurements. This study will provide results on this matter.

The average of face width has been found to increase slightly during adulthood. Studies on Caucasian males by Baer (1956) and Goldstein (1936) suggested that the increase was approximately 1 mm during the third decade of ontogeny, and another 1 mm during the succeeding half century. The average of face height increases about 2 mm during the third decade of ontogeny, and another 1 mm during the succeeding half century. The average of face height increases about 2 mm during the third decade, then decreases fully twice this amount in the old age. Thus, for the purpose of this current study, the samples were adults rather than youngsters, subadults, or older people, to give more stable cephalofacial morphology.

The aims of the study are: (1) to test whether the differences between sexes in the samples from Alor, Atoni, Barawahing, East Alor, Java, Kabir, Lemma, Manggarai, Marai, Middle Pantar, Ngada, Palue and Tetum, is greater or smaller compared to the differences between samples, (2) to determine whether the samples and sexes can be significantly differentiated from each other from a set of cephalometric data, and (3) to see the Mahalanobis distance between the samples. The comparison of the groups of population is not only useful as a basic study, but could be used in forensics for the determination of ethnic identity and sex category.

METHODS

There were a total of 3822 individuals from Alor, Atoni, Barawahing, Marai, Tetum, Java, Kabir, Lemma, Manggarai, Middle Pantar, Ngada, East Alor and Palue. The smallest sample (45 individuals) was from Marai and consisted of 35 males and 10 females. The smallest number (5 individuals) was female sample from Tetum (Table 1). The sample from Java was the largest, consisted of 579 males and 507 females. The samples measured by trained anthropologists.

Table 1. The Frequency of Samples

Sample	Frequency		
	All	**Males**	**Females**
Alor	254	231	23
Atoni	108	84	24
Barawahing	382	324	58
Kabir	91	70	21
Lemma	216	146	70
Manggarai	106	79	27
Marai	45	35	10
Middle Pantar	286	237	49
Ngada	83	58	25
East Alor	299	231	68
Palue	815	518	297
Tetum	51	46	5
Java	1086	579	507
Total	3822	2638	1184

The variables analyzed in the research were maximum head length (g-op), maximum head breadth (eu-eu), minimum frontal breadth (ft-ft), maximum bizygomatic breadth (zy-zy), bigonial breadth (go-go), maximum physiognomic nasal breadth (al-al), nasal length (n-sn), and morphological height of face (n-gn).

The indices were calculated from those facial and cranial measurements. The classifications of the indices are based on Martin's, and Saller's (Glinka, 1990), as shown below:

1) Classification of Cephalic Index by Saller:

	male	female
hyperdolichocephal	x-70.9	x-71.9
dolichocephal	71.0-75.9	72.0-76.9
mesocephal	76.0-80.9	77.0-81.9
brachycephal	81.0-85.4	82.0-86.4
hyperbrachycephal	85.5-90.9	86.5-91.9
ultrabrachycephal	91.0-x	92.0-x

2) Classification of Total Face Index by Martin:

	male	female
hypereuryprosop	x-78.9	x-76.9
euryprosop	79.0-83.9	77.0-80.9
mesoprosop	84.0-87.9	81.0-84.9
leptoprosop	88.0-92.9	85.0-89.9
hyperleptoprosop	93.0-x	90.0-x

3) Classification of Jugomandibular Index by Martin:

	male	female
very narrow	x-69.9	x-67.9
narrow	70.0-74.9	68.0-72.9
moderate	75.0-79.9	73.0-77.9
wide	80.0-84.9	78.0-82.9
very wide	85.0-x	83.0-x

4) Classification of Jugofrontal Index by Martin:

	male	female
very narrow	x-69.9	x-71.9
narrow	70.0-74.9	72.0-76.9
moderate	75.0-79.9	77.0-81.9
wide	80.0-84.9	82.0-86.9
very wide	85.0-x	87.0-x

5) Classification of Nasal Index by Martin:

hyperleptorrhin	x-54.9
leptorrhin	55.0-69.9
mesorrhin	70.0-84.9
chamaerrhin	85.0-99.9
hyperchamaerrhin	100.0-x

Classificatory discriminant analysis was used to differentiate the groups, and assigning an unknown individual into a group (Glinka, 1991), on the basis of one or more quantitative variables. This analysis reduces the dimension from a very large number of characteristics to a relatively few linear combinations, and displays the relationships and possible groupings.

The morphometric distance between the samples was determined by Mahalanobis distance. The D^2 is computed from the differences of the mean measurements. Indices were not included in the calculation of Mahalanobis distance.

RESULTS

The result showed that the samples were classified into 3 groups. Group 1 consisted of samples from Alor, East Alor, Barawahing, Kabir, Lemma and Middle Pantar. Group 2 consisted of samples from Atoni, Manggarai, Marai, Ngada, Palue and Tetum.

The Java sample, which had the farthest Mahalanobis distance to the other samples, was clustered into one separate group (Group 3). Group 3 had the characteristics of broad head, forehead, cheek-bones, and mandible; small nose, narrow nostril, and long face. Group 2 had the characteristics of narrow head, cheek-bones, and mandible; high value in total face index--face height was high relative to the width of the cheek-bone, high value of TFI--frontal head was broad relative to the breadth of the head. Group 1 had the characteristics of long head, broad head and cheek-bone, small value of Temporofrontal Index--frontal head was narrow relative to the head breadth, low value of Cephalic Index--head breadth was narrow relative to the length of the head, and small value of Jugofrontal Index--frontal head was narrow relative to the breadth of the head. The plots of male (Figure 1) and female (Figure 2) samples showed that they were dispersed into 3 groups.

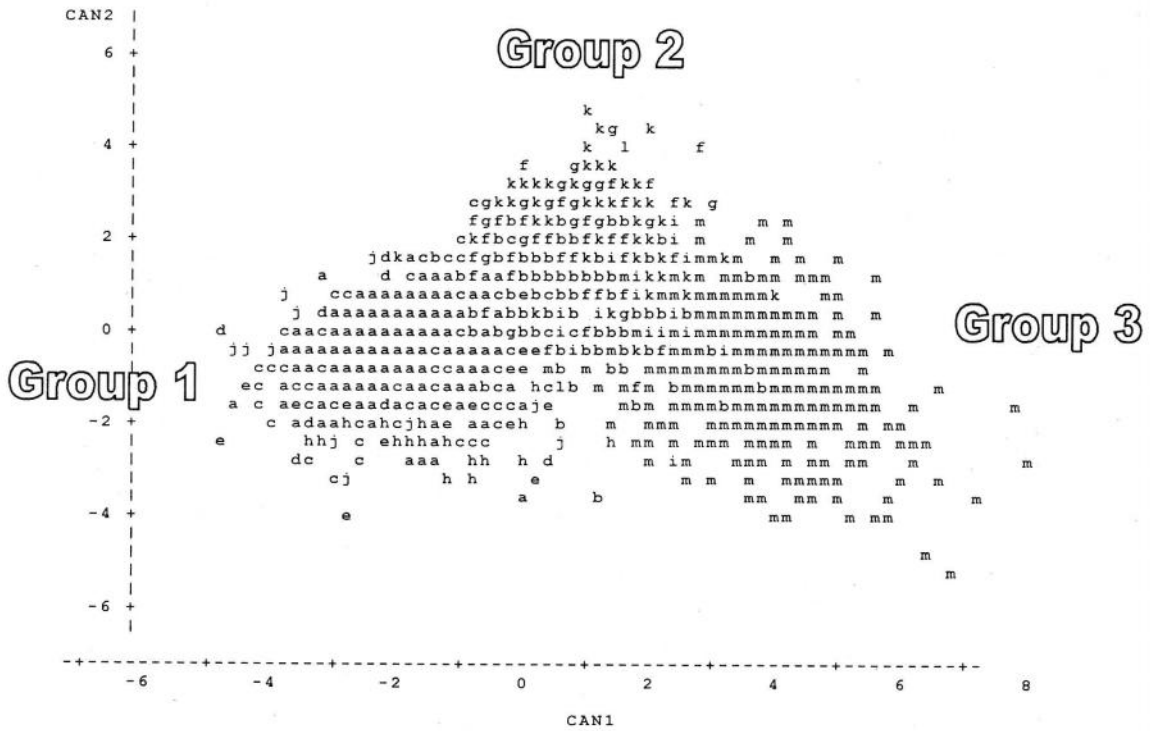

Figure 1. The plot of male samples. The samples are segregated into 3 groups. Group 1 = a (Alor), c (Barawahing), d (Kabir), e (Lemma), h (Middle Pantar), j (East Alor); Group 2 = b (Atoni), f (Manggarai), g (Marai), i (Ngada), k (Palue), l (Tetum), Group 3 = m (Java)

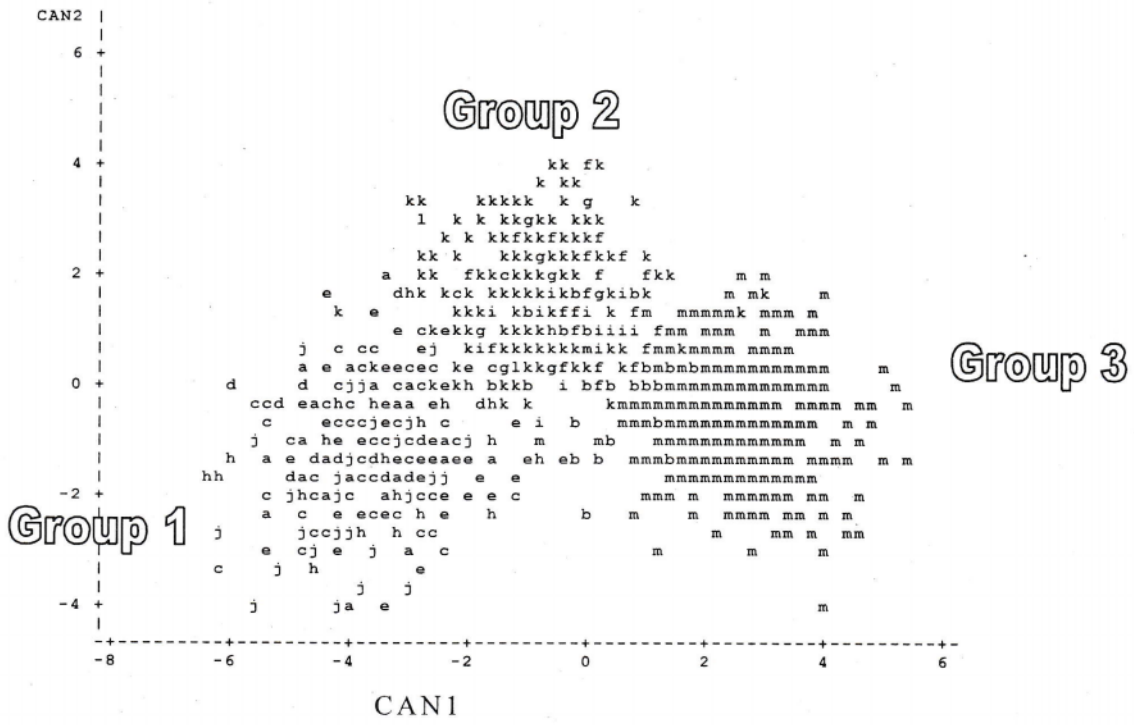

Figure 2. The plot of female samples. The samples are segregated into 3 groups. Group 1 = a (Alor), c (Barawahing), d (Kabir), e (Lemma), h (Middle Pantar), j (East Alor); Group 2 = b (Atoni), f (Manggarai), g (Marai), l (Ngada), k (Palue), l (Tetum), Group 3 = m (Java)

Table 4. Wilks' Lambda between samples and sex groups

Statistic	Value	F	Num DF	Den DF	Pr > F	S
Between samples	0.07	70.54	168	34862.88	0.0001	12
Between sex	0.53	240.47	14	3807.00	0.0001	1
Males	0.07	48.25	168	23995.93	0.0001	12
Females	0.05	25.28	168	10650.87	0.0001	12

The Mahalanobis distance between male samples are shown in Table 2, which ranged from 0.07 to 32.32. The Mahalanobis distance values of the female samples are shown in Table 3, which ranged from 0.47 to 40.45. In both sexes, generally Java had bigger distances to the other groups, compared to the distances between other groups.

Tabel 2 and 3

TABLE 2. Mahalanobis squared distances between male samples

From	Squared Distance to Sample												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0												
2	10.42	0											
3	0.53	8.64	0										
4	0.66	10.48	0.99	0									
5	2.07	11.07	1.90	1.71	0								
6	10.77	2.25	9.47	9.88	11.67	0							
7	14.37	4.43	12.99	14.11	16.28	2.22	0						
8	1.38	10.11	1.55	1.72	0.54	10.66	15.25	0					
9	11.96	1.66	9.79	11.58	11.22	1.37	3.74	10.43	0				
10	0.54	8.51	0.07	1.08	1.82	9.52	13.01	1.47	9.79	0			
11	10.64	2.55	9.34	9.64	11.21	0.93	2.96	10.76	1.59	9.37	0		
12	12.15	2.20	10.69	11.92	13.87	1.45	0.71	12.98	2.47	10.58	1.87	0	
13	31.81	10.37	29.44	32.32	29.95	13.90	19.36	28.49	10.48	29.55	15.41	16.47	0

1Note: 1= Alor, 2= Atoni, 3= Barawahing, 4= Kabir, 5= Lemma, 6= Manggarai, 7= Marai, 8=Middle Pantar, 9= Ngada, 10= East Alor, 11= Palue, 12= Tetum, 13= Java

TABLE 3. Mahalanobis squared distances between female samples

From	Squared Distance to Sample												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0												
2	21.12	0											
3	0.47	19.19	0										
4	1.32	19.97	1.94	0									
5	4.60	15.75	4.66	2.74	0								
6	22.11	4.79	20.96	18.32	16.87	0							
7	20.26	5.05	19.16	17.77	17.30	3.65	0						
8	1.87	17.52	1.10	1.62	1.27	18.78	19.17	0					
9	19.58	3.18	17.65	16.74	14.62	2.58	4.63	16.17	0				
10	0.67	20.70	0.54	2.32	3.95	23.48	21.95	1.36	19.30	0			
11	17.22	6.60	15.76	14.48	13.52	2.49	4.53	14.90	2.40	18.36	0		
12	12.59	12.76	13.30	10.54	12.43	6.70	6.78	13.11	10.63	16.11	5.32	0	
13	40.45	6.79	37.76	39.90	31.79	12.36	16.66	34.48	12.12	39.56	15.89	24.48	0

2Note: 1= Alor, 2= Atoni, 3= Barawahing, 4= Kabir, 5= Lemma, 6= Manggarai, 7= Marai, 8=Middle Pantar, 9= Ngada, 10= East Alor, 11= Palue, 12= Tetum, 13= Java

The Wilks' Lambda is the ratio of generalized variances. It is an inverse statistic that considers inter-group heterogeneity and intra-group homogeneity (Klecka, 1980). Ho is rejected if the value is small. The Wilks' Lambda between the sex groups (0.53) is larger than the Wilks' Lambda between samples (0.07) (Table 4). It means that the difference within male and female samples were larger than the difference between overall samples. Males' cephalometric features across the samples resembled each other more than those of males and females in one sample. Females' cephalometric features across the samples also resembled each other more than males and females in one sample.

Males had more characteristic of long head, broad cheek-bone, nostril, and mandible, the breadth of the head was narrow in relative to the length of the head, the breadth of front-head was narrow relative to the breadth of the head, and the face length was short relative to the broad cheek-bone. In males, the frontal-bone width was broader in relation to the head breadth, the jaw was broader in relation to the cheek-bones, and the nostril was wider in relation to the nose.

Females tended to be smaller than males in cephalofacial morphology. The sex differences were most obvious in the head length and nasal index. Females had different ratio of indices compared to those of males. Cephalic index, jugofrontal index, and total face index had higher values in females compared to males. In females, the head breadth was relatively wider than males, in relation to head length; the frontal head was relatively wider in relation to cheek-bones, and the total face length was higher in relation to cheek-bones.

The percentage of males classified to the correct ethnic group ranged from 17.7 % to 83.4% (Table 5). Meanwhile, 18.37% to 86.19% of females were classified to the correct ethnic groups (Table 6). More than 40% were correctly classified in 5 samples of males, and 8 samples of females. The 0% misclassifications were found more in females than males. Most of 0% misclassifications in males were found between samples belonging to discrete groups, for example, 0% misclassifications were found more in females than males. Most of 0% misclassifications in males were found between samples belonging to discrete groups, for example, 0% misclassifications were found between Alor (Group 1) and Marai (Group 2), Lemma (Group 1) and Tetum (Group 2), Kabir (Group 1) and Java (Group 13), East Alor (Group 1) and Ngada (Group 2), etc.

Tabel 5 and 6

TABLE 5. The percentage of males classified correctly

	Percent Classified into Sample:													
From	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1	27.27	0.87	8.66	17.32	11.26	0.43	0.00	15.58	0.00	15.58	2.16	0.87	0.00	100.00
2	0.00	34.52	2.38	3.57	0.00	5.95	9.52	1.19	8.33	0.00	13.10	14.29	7.14	100.00
3	14.81	1.54	22.22	9.88	12.96	1.23	2.16	12.65	1.23	18.52	1.23	1.54	0.00	100.00
4	17.14	1.43	7.14	37.14	12.86	0.00	0.00	10.00	1.43	10.00	1.43	1.43	0.00	100.00
5	6.85	2.74	6.85	9.59	46.58	0.68	0.68	19.86	2.05	4.11	0.00	0.00	0.00	100.00
6	0.00	7.59	1.27	0.00	1.27	17.72	12.66	0.00	18.99	0.00	21.52	16.46	2.53	100.00
7	0.00	0.00	5.71	0.00	0.00	5.71	45.71	0.00	14.29	0.00	17.14	11.43	0.00	100.00
8	10.97	1.69	4.64	6.75	27.00	1.27	0.00	35.02	0.84	9.70	1.27	0.42	0.42	100.00
9	0.00	6.90	0.00	0.00	0.00	8.62	8.62	1.72	46.55	0.00	15.52	6.90	5.17	100.00
10	10.39	3.03	17.32	12.55	12.12	0.87	0.43	11.69	1.30	27.71	1.73	0.87	0.00	100.00
11	0.97	5.02	0.58	2.51	1.16	11.20	11.00	1.54	14.09	0.97	43.24	7.34	0.39	100.00
12	0.00	10.87	2.17	0.00	0.00	10.87	26.09	0.00	13.04	0.00	10.87	26.09	0.00	100.00
13	0.00	5.70	0.00	0.00	0.00	1.21	0.69	0.00	8.12	0.00	0.52	0.35	83.42	100.00

3Note: 1=Alor, 2=Atoni, 3= Barawahing, 4= Kabir, 5= Lemma, 6= Manggarai, 7= Marai, 8=Middle Pantar, 9= Ngada, 10= East Alor, 11= Palue, 12= Tetum, 13= Java

TABLE 6. The percentage of females classified correctly

	Percent Classified into Sample:													
From	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1	21.74	0.00	13.04	8.70	13.04	0.00	0.00	4.35	0.00	34.78	0.00	4.35	0.00	100.00
2	0.00	70.83	0.00	0.00	0.00	4.17	8.33	0.00	8.33	0.00	4.17	0.00	4.17	100.00
3	8.62	0.00	34.48	8.62	6.90	0.00	3.45	10.34	0.00	22.41	5.17	0.00	0.00	100.00
4	19.05	4.76	9.52	33.33	19.05	0.00	0.00	9.52	0.00	4.76	0.00	0.00	0.00	100.00
5	5.71	2.86	5.71	8.57	51.43	0.00	0.00	11.43	2.86	8.57	1.43	1.43	0.00	100.00
6	0.00	7.41	0.00	0.00	3.70	48.15	14.81	0.00	14.81	0.00	7.41	3.70	0.00	100.00
7	0.00	20.00	0.00	0.00	0.00	0.00	50.00	0.00	10.00	0.00	0.00	20.00	0.00	100.00
8	6.12	0.00	14.29	4.08	34.69	0.00	0.00	18.37	2.04	18.37	0.00	2.04	0.00	100.00
9	0.00	0.00	0.00	0.00	8.00	12.00	8.00	0.00	48.00	0.00	24.00	0.00	0.00	100.00
10	14.71	0.00	20.59	11.76	13.24	1.47	0.00	10.29	0.00	27.94	0.00	0.00	0.00	100.00
11	0.00	5.39	0.67	0.67	1.35	8.42	9.43	0.67	12.46	0.00	49.83	10.44	0.67	100.00
12	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00	20.00	0.00	0.00	60.00	0.00	100.00
13	0.00	9.47	0.00	0.00	0.00	0.39	1.18	0.00	2.76	0.00	0.00	0.00	86.19	100.00

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4 Note: 1=Alor, 2=Atoni, 3= Barawahing, 4= Kabir, 5= Lemma, 6= Manggarai, 7= Marai, 8=Middle Pantar, 9= Ngada, 10= East Alor, 11= Palue, 12= Tetum, 13= Java

The percentage of misclassifications from males to females was 14.44%, and from females to males was 15.96% (Table 7). It means that 84% of females and 86% of males could be classified to the correct sex category.

between males and females.

The groups of sample were divided into 3 bigger lumps that were consistent for males and females. The Mahalanobis squared distance showed consistency between males and females as

Table 7. The percentage of classifications in males and females

	Number of Observations and Percent Classified into SEX TYPE:		
SEXTYPE	female	male	Total
female	995 84.04%	189 15.96%	1184 100.00%
male	381 14.44%	2257 85.56%	2638 100.00%
Total	1376	2446	3822

DISCUSSION

The variations within the samples were larger than the variations between the samples, in the morphological features of the head and face. However, the overlapping was less when each sample was separated into three groups based on the cephalometric variables using multivariate analysis.

It was difficult to compare intergroup variability characteristics because the number of samples available, especially the female samples were relatively small. However, the male samples should be reasonably reliable, because the number of samples were adequate.

Females tended to be smaller than males in cephalofacial morphology. The sex differences were most obvious in the head length and nasal index. Other studies have confirmed that the growth rate of face was different between males and females. It was assumed that it was also the case in the samples studied here. The sex difference in several cephalometric measurements might be caused by the different rate and duration of growth

well. The very small values of distances between Alor and Barawahing, Alor and East Alor, and between Barawahing and East Alor were found for males and females.

The segregation of the samples into three groups was consistent not only with the similarity of the physical appearance, based on the head and face measurements, but also with the geographic locations and especially with the language spoken by each groups. The samples belonging to the first group--Alor, East Alor and Barawahing--live on Alor Island. These three ethnic groups have very small values for Mahalanobis squared distance in male and female samples. The neighboring island of Alor is Pantar, which is inhabited by Kabir, Middle Pantar and Lemma ethnic groups. The distance between Lemma and Middle Pantar was also very small. Interestingly, the distance between Kabir and Lemma and between Kabir and Barawahing, who live in the neighboring island, were smaller than the distance between Kabir and Lemma and between Kabir and Middle Pantar, which are at the same island. The people

from Kabir seem to prefer crossing the island to Alor than travelling to the inner part of the island.

The second group--Atoni, Manggarai, Marai, Ngada, Palue, and Tetum--also live on islands that are located close to each other. The Atoni, Tetum, and Marai live on Timor island, Manggarai and Ngada live on Flores Island, while Palue is a separate little island north of Flores. The Mahalanobis distance between Marai and Tetum, who live very close to each other, was very small. The Mahalanobis distance between Atoni and the other ethnic groups on the same island--Tetum and Marai--was also small. The second subgroup--Manggarai, Ngada and Palue--also showed small Mahalanobis distance values between each other. Manggarai and Ngada are two large ethnic groups, that speak different languages but still have the same language family, Malayo-Polynesian. Interestingly, the Mahalanobis distance between Atoni and the other ethnic groups on the same island--Tetum and Marai-- was also small. The second subgroup--Manggarai, Ngada and Palue--also showed small Mahalanobis distance values between each other. Manggarai and Ngada are two large ethnic groups, that speak different languages but still have the same language family, Malayo-Polynesian. Interestingly, the Mahalanobis distance between Palue and Manggarai for males was very small (0.93), and 2.49 for the females. According to Portuguese seafarers, there was a folklor in Palue that revealed the history of the past colonization of the island by all males pirates. Glinka (personal communication, 2007) hypothesized that they took their wives from the neighbouring island (Flores). The folklor stated that the people's origin was from Flores. It probably explains the very small Mahalanobis distance between Palue and Manggarai.

The Ngada, who traditionally believe that their ancestor came from Java, showing large Mahalanobis distances to Javanese males (10.48), and to Javanese females (12.12). However, hose Mahalanobis distances were relatively small compared to the Mahalanobis distances between Java and other ethnic groups.

Java and Atoni also had similar value of Mahalanobis distance (10.37) to those of Java-Ngada. It had been long suspected that Atoni had contacts with the ancient Hindu-Javanese culture, as indicated from the Atoni political and religious constitutions.

Javanese belonged to a separate group, compared to the other ethnic groups in east Indonesia--group 1 and group 2, based on the cephalofacial morphology. Not only the cephalofacial morphology was different, but also the language spoken in Java belongs to West Indonesian Hesion (branch), the Hesperonesian subfamily of the Malayo-Polynesian language family, while Tetum belongs to Moluccan Linkage (Glinka, 1978). Earlier, Dyen (1962, 1965) had pointed out the diversity of the languages in the Indonesian regions. Based on Dyen, Glinka (1978) did further research, and concluded that the Atoni, Ngada and Manggarai were clustered into one group. This is in accordance with the result of this study, which grouped Atoni, Ngada and Palue into one group (Group 2). Furthermore, a study of 9 languages (Manggarai, Ngada, Palue, Lio, Rembong, Komodo, Sika, Lamalohot, and Kedang) in Flores area by Fernandez (1996) concluded that Ngada, Palue and Manggarai were clustered together into one subgroup, the West Flores language group. This is in accordance with the small Mahalanobis distance between Manggarai-Palue, Ngada-Palue, and Manggarai-Ngada, in this study.

According to Keraf (1984), the Javanese language belongs to West Indonesian group, while the rest of the samples belongs East Indonesian language group. Further he stated that the East Indonesian language group was split into 3 subgroups: the Timor-Ambon, the Sula-Bacan, and the South Halmahera-West Irian. Together, Alor, Pantar, Kabir, Lemma and Tetum belonged to Timor-Ambon subgroup. However, within this subgroup, Alor, Pantar, Kabir and Lemma belonged to "Kedang-Alor-Pantar" language group, while Tetum belonged to

"Timor-Timur" language group. Those are in accordance with the results of this study, which put together Alor, Pantar, Kabir and Lemma into Group 1, and Tetum was in Group 2.

In general, anthropometric distances in this research have been proven to be in accordance with the linguistic aspect. This research has given a light to understanding that people migration did not simply correlate to the geographic distance. Genetic distance—such as reflected by anthropometric distance—may be in accordance with the cultural aspects and history of the people.

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