

## Research Report

## Dental measurements of Deuteromalayid Javanese students of the Faculty of Dentistry Airlangga University

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### ABSTRACT

**Background:** Dental anthropology is a new field of study in Indonesia, hence there are few numbers of research that can be found in this field. Knowledge in this field is needed due to the large area and diversity of the people. Moreover, knowledge regarding the possibility to differentiate the sexes of skeletons is still needed for the purpose of identification. **Purpose:** This research intended to study the differences in mesio-distal measurements of the teeth of Deuteromalayid Javanese males and females studying in the Faculty of Dentistry in Airlangga University. **Methods:** This study used mesiodistal metric dental data, using dental caliper, to test the existence of sexual dimorphism. Sample were teeth of freshman students of the Airlangga University, from 52 individuals comprising 26 males and 26 females Deuteromalayid originated from Java (Indonesia) studying in the Faculty of Dentistry Airlangga University. Measurements were not performed on damaged casts due to caries or other reasons. Differences between males and females were tested using independent t-test. **Results:** The mean of mesiodistal measurements in males and females differs, where the males have greater size of mesiodistal measurements. The results showed that there were significant differences between sexes in the sample, in all field of teeth except the second upper and lower premolars. Reverse sexual dimorphism-female teeth measurement is larger than those of males-has not been found in these samples. The result of this study revealed that the range of mesiodistal measurements of every tooth in males and females overlapped. **Conclusion:** It is concluded that teeth measurement of males is bigger than females, except maxillary and mandibular second premolars.

**Key words:** Teeth measurement, sex, mesio-distal, odontometry, sexual dimorphism

### ABSTRAK

**Latar belakang:** Antropologi dental adalah bidang studi baru di Indonesia, dan karenanya penelitian di bidang ini masih sedikit dijumpai di Indonesia. Apalagi masih dibutuhkan pengetahuan mengenai apakah jenis kelamin dapat dilihat dari geligi tengkorak manusia, untuk keperluan identifikasi. **Tujuan:** Tujuan penelitian ini adalah untuk mengetahui perbedaan ukuran mesiodistal gigi antara laki-laki dan perempuan Deuteromalayid dari Jawa. **Metode:** Penelitian ini menggunakan data pengukuran mesio-distal gigi untuk mengetahui apakah ada perbedaan antar jenis kelamin pada ukuran gigi mahasiswa Fakultas Kedokteran Gigi Universitas Airlangga keturunan Deuteromalayid dari Jawa. Penelitian ini merupakan penelitian tahap awal dengan jumlah sampel yang masih terbatas. Sampel diambil dari 52 orang individu yang bersedia dicetak giginya dengan jumlah 26 laki-laki dan 26 perempuan. Pengukuran dilakukan dari mesial ke distal gigi. Pengukuran tidak dilakukan mesial gigi yang mengalami kerusakan seperti misalnya karena karies atau aus yang parah. Signifikansi perbedaan antar jenis kelamin dianalisis menggunakan independent t-test. **Hasil:** Hasil penelitian menunjukkan bahwa terdapat perbedaan yang signifikan antar laki-laki dan perempuan di semua jenis gigi, kecuali pada premolar ke dua atas dan bawah. "Reverse sexual dimorphism" di mana rata-rata ukuran gigi perempuan lebih besar dari laki-laki, tidak ditemukan pada sampel ini. Pada penelitian ini meskipun dijumpai "overlap" pada ukuran gigi laki-laki dan perempuan, tetapi sebagian besar rata-rata ukuran gigi berbeda secara bermakna antar kedua jenis kelamin pada sampel mahasiswa Fakultas

*Kedokteran Gigi Universitas Airlangga yang berasal dari Jawa keturunan Deuteromalayid. Kesimpulan: Dapat disimpulkan bahwa pengukuran gigi laki-laki lebih besar daripada perempuan, kecuali premolar kedua maksila dan mandibula.*

**Kata kunci:** Ukuran gigi, jenis kelamin, morfometri, mesio-distal, odontometri, dimorfisme seksual

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## INTRODUCTION

Dental anthropology is a new field of study in Indonesia, hence there are few numbers of research can be found in this field. Knowledge in this field is needed due to the large area and diversity of the people. Anthropometrical research has been done several times,<sup>1-8</sup> but research in sexual dimorphism of the groups of people dwelling in this area based on dental research has not been found.

Indonesia is a large country, occupied by more than 200 million of people who live in chains of islands. Some of the islands are isolated from each other, but some other islands can be reached by the neighboring islands inhabitants easily. The isolations and the bridging between the islands that changed from time to time may cause the similarity and dissimilarity of the morphology of the people, as well as different pattern of dental traits variation, and dental measurements.

Species other than human primates showed so much of differences between the sexes.<sup>9</sup> However, different developmental processes can produce traits that appear similar at the enamel surface, suggesting caution in intra- and intertaxonomic comparisons,<sup>10</sup> so that comparison of sexual dimorphism with other species may not be possible.

Sexual dimorphism in teeth size has been found in several studies, but the pattern is less consistent. If dental measurements in Javanese sample showed an indication of sexual dimorphism, it might be used as a tool for identifying individuals such as in forensics cases.

## MATERIALS AND METHODS

A number of 52 Javanese subjects were observed in 2009. The sample consisted of 26 males and 26 females aged 18 to 20 years of age. The sample came from freshman students of the Faculty of Dentistry Airlangga University so that the age may not exceed 20 years of age.

The casts were made out of the teeth of subjects who were willing to participate for this study. Subjects were assigned to Javanese only if both parents belonged to that ethnic group. Observations were written down on a form and subsequently transferred to Excel spreadsheets. Observations were not made on damaged casts due to caries or other reasons.

Tooth diameters were recorded with a calliper accurate to 0.5 mm. The maximum lengths of left and right antimeres

of all permanent teeth were measured, and the measurements of the tooth in question taken as the average of both sides. Where only one of the antimeres could be measured, its diameters were used, and where neither of the antimeres could be accurately measured—such as carries, incomplete or non-eruption, excessive wear, or cast damage—no value was recorded. Although a study reported that heavily worn teeth may be measured because of the strong correlation between the crown measurements and cervical measurements,<sup>11</sup> it is decided to use only teeth that are not heavily worn.

The measurements were using callipers instead of scanning the objects with computed tomography, and measurements were made digitally with a 3-dimensional-based dental measurements program (3DD, Biodent, Cairo, Egypt). The reason was simply because the researchers did not have the device to do the computed tomography. Besides, according to El Zanaty *et al.*,<sup>12</sup> there was no significant differences between the 3DD and conventional measurements.

Differences between males and females were tested using independent t-test. The differences were significant when the value were 0.05 and below.

## RESULTS

It shows that the mean of mesiodistal measurements in males and females, where the males have greater size of mesiodistal measurements (Table 1). The larger size of the male teeth of the males, compared to their female counterparts, is usually in evidence, as expected.<sup>13,14</sup> However the result if this research revealed that the differences between the sexes were significant in all field except in upper and lower second premolars.

The insignificant differences between the males and females in upper and lower premolar were caused by the diversity of the measurements of those teeth, both in males and females. Therefore, the overlapping of measurements was also great, in those two teeth, between the males and the females.

In the upper canine, a measurement between 5.8 mm and 6.4 mm would almost be certain to be a female, and in the lower canine, a measurement between 4 mm and 5.9 mm would almost be certain to be a female. Meanwhile, measurements of the upper and lower canines between 8.1 mm and 9 mm would be on a male subject.

In the upper second incisor, a measurement between 7.6 mm and 9 mm would almost be certain to be a male,

**Table 1.** The number of sample, minimum, maximum, mean, standard deviation, and the significance of differences between males and females

	Males					Females					Sig. (2-tailed)
	n	Min	Max	Mean	s	n	Min	Max	Mean	s	
UC	26	6.5	9.0	7.7	0.68	26	5.8	8.0	7.1	0.53	0.001
UI2	26	5.5	9.0	6.9	0.74	26	5.5	7.5	6.3	0.46	0.001
UI1	26	7.0	9.5	8.3	0.73	26	7.0	9.0	7.8	0.48	0.004
UP2	26	4.0	9.0	6.6	0.96	25	5.0	10.0	6.4	0.95	0.467
UP1	26	6.0	8.0	7.2	0.58	26	6.0	7.0	6.5	0.54	0.001
UM2	26	8.0	11.0	9.6	0.75	25	8.0	10.0	8.6	0.67	0.001
UM1	26	5.5	12.0	10.4	1.26	26	8.5	10.3	9.7	0.44	0.007
LC	26	6.0	9.0	6.9	0.60	26	4.0	8.0	6.0	0.70	0.001
LI2	26	5.0	7.0	6.2	0.64	26	5.0	6.0	5.5	0.49	0.001
LI1	26	4.8	8.0	5.9	0.76	26	4.0	5.8	5.0	0.31	0.001
LP2	26	5.0	8.5	7.0	0.77	26	3.5	10.0	6.6	1.18	0.229
LP1	26	6.0	8.0	7.0	0.54	26	6.0	7.5	6.6	0.46	0.002
LM2	26	6.0	13.0	10.3	1.41	26	5.0	11.0	8.9	1.37	0.001
LM1	26	6.0	13.0	10.9	1.23	26	6.0	11.0	9.8	1.03	0.002

Notes: UC: upper canine, UI2: upper second incisor, UI1: upper first incisor, UP2: upper second premolar, UP1: upper first premolar, UM2: upper second molar, UM1: upper first molar, LC: lower canine, LI2: lower second incisor, LI1: lower first incisor, LP2: lower second premolar, LP1: lower first premolar, LM2: lower second molar, LM1: lower first molar

while in the lower second incisor, a measurement between 6.1 mm and 7 mm would almost be certain to be a male. Measurements below 7.6 in the upper second incisor and below 6.1 in the lower second incisor would be difficult to decide whether it belongs to a male or a female.

A measurement between 9.1 mm and 9.5 mm of the upper first incisor would certainly grouped into male, while the lower first incisors could be differentiated more into males and females. A measurement between 4 mm and 4.7 mm belonged to a female, and between 5.9 mm and 8 mm belonged to a male.

The upper second premolar overlapped greatly so that it was difficult to differentiate. Meanwhile, the lower second premolar that had a measurement between 3.5 mm and 4.9 mm belonged to a female.

An upper first premolar that had a measurement between 7.1 mm and 8 mm belonged to a male. A measurement of the lower first premolar between 7.6 mm and 8 mm belonged to a male.

The measurement of upper second molar that fell between 10.1 mm and 11 mm would be grouped into a male. The lower second molar could be grouped further. A measurement fell between 5 mm to 5.9 mm belonged to a female, and a measurement between 11.1 mm to 13 mm belonged to a male.

When the measurements of the upper first molar fell between 10.4 mm and 12 mm, it would be grouped into a male. Lower first molar measurement that fell between 11.1 mm and 13 mm was grouped into a female.

## DISCUSSION

According to Barrett *et al.*,<sup>15</sup> based on the coefficients of variation, the third molars and the maxillary lateral incisors varied most in size and the first molars least. In the samples of the present study in both males and females the mandibular second molar showed relatively large size variability. The least varied in tooth size was found in lower first incisors (LI1) in females, and lower first premolar (LP1) in males.

The mesiodistal molar crown diameters of these teeth ranged from 6 mm to 13 mm in males, and from 6 mm to 11 mm in the females. Barrett *et al.*,<sup>15</sup> found somewhat larger teeth sizes in his study, between 10.50 mm to 13.60 mm. The mandibular first molars is larger than mandibular second molars, so is the case of the upper molars. These findings were found in both males and females.

Several authors<sup>16–19</sup> had drawn attention to the fact that in general tooth size and morphology were more stable in the mesial teeth than in the distal teeth within each tooth group, but here the reverse was true for the maxillary molars of males, and maxillary upper incisors of females.

Reverse sexual dimorphism-female teeth measurement is larger than those of males-has not been found in this sample such as found in Prabhu and Acharya.<sup>20</sup> This is not surprising because comparisons of sexual dimorphism in teeth between different populations showed that it differed among different groups.<sup>21</sup>

The degree of dimorphism varies within different populations although usually males have bigger tooth crowns than females even in recent human populations.<sup>22</sup> Although modern human did not emerge as significantly dimorphic as fossilized hominids, it is well-known that sexual dimorphism in canine exists.<sup>23</sup> It was suggested that canine dimorphism is not developmentally homologous across primates.<sup>24</sup> Furthermore those researchers argued that there were growth rate differences between males and females resulting in canine dimorphism in primates, including human primate. Recent studies have shown that dimorphism is the product of changes in both male and female traits, and developmental studies demonstrate the variety of ontogenetic pathways that can lead to dimorphism.<sup>25</sup> Similar degree of sexual dimorphism such as in recent human seems to have existed in *Australopithecus anamensis* (living approximately 4 million years ago) from estimated canine crown heights, suggesting a low degree of sexual dimorphism.<sup>26</sup>

The result of this study revealed that the range of mesiodistal measurements of every tooth in males and females overlapped. This is similar to the size of body of males and females. This will make it more difficult to assign the sex of a single tooth. However, someone can always be stated that overall teeth size of females is significantly smaller than those of males.

The size of the permanent human canine is one of the few sexually dimorphic features to be present in childhood and as such offers the opportunity to assist in the identification of sex in remains where no other appropriate criteria exist, such as in subadults.<sup>27</sup> This sexual dimorphism in mesiodistal measurements canines of this sample showed highly significant differences-0.000 in lower canine and 0.001 in upper canine-which can be used as one of the teeth to aid sex identification.

Upper canine had significant mean differences in all measurements in Swedish population.<sup>28</sup> In this research, however, the most dimorphic mesiodistal measurements were found in upper first premolar, upper second molar, lower first and second incisors, and lower canine.

It would be easier to assign the sex of a single tooth in cases where the tooth falls at the lowest end of range, or at the highest end of range. For example, an upper canine which has the mesiodistal measurement of 8 mm or above would be a male, and an upper canine which has the mesiodistal measurement of 6 mm or smaller would be a female. When the measurement of one tooth falls into the overlapping area, it is best to measure the complete set of teeth, as stated by Prabhu and Acharya<sup>20</sup> that “the teeth from both jaws taken together were able to determine sex to higher levels”.

When compared to other population, according to Kuswandari and Nishino,<sup>8</sup> the mean of Javanese mesiodistal crown measurements fell between Hong Kong Chinese and Australian Aboriginal. It is suggested that the mean varied between populations. It should be noted that Indonesia has a wide diversity of population, ranging from Deuteromalayid at the western part to Australomelanesoid at the eastern

part. It is therefore exceptional to assume that there is a significant difference between the western population and the eastern population in Indonesia, regarding the mean of mesiodistal measurements of teeth. Assessment of variation in dental size gives a clue about the behavior of a population.<sup>29</sup>

The next step after measurement is considering the correlation of size to shape of teeth, which was not done in this research. This information can be obtained by calculating the correlation of two measurements within the same tooth. This should be done in a bigger size of sample. It then could be compared to other populations whether the sexual dimorphism is greater or less than those of other populations. According to Ateş *et al.*,<sup>29</sup> the sexual dimorphism of populations could be different between one to another.

It is concluded that teeth measurement of males is bigger than females, except maxillary and mandibular second premolars. Larger sample size will be useful to find more evidence of differences in the tooth size in each field. Further research involving other dental traits for sexual dimorphism studies would be useful.

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