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Dental age estimation using demirjian method on children of javanese ethnic in jember

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Abstract
Background: Dental age estimation aims to provide data in the field of dentistry with an accurate dental age range. To get the value of an accurate estimate of dental age, needed a method of estimation that has a standard deviation as low as possible and is validated in a specific population group of an individual. Demirjian method is a method frequently used in dental age estimation. This method uses the classification stages of the seven permanent teeth of the mandibular left side using panoramic radiographs. Demirjian method uses a standard called Demirjian standard in the form of the self-weighted score for dental stages of 7 teeth (Mandibular left side) and conversion table of maturity to dental age. Application of the Demirjian method in some countries gets the results to vary so it is recommended to make adjustments to this method.
Purpose: The purpose of this study was to assess the dental age estimation using the Demirjian method on children of Javanese ethnic in the Jember region.
Method: This study used an analytic descriptive study design. The samples used in this study are the panoramic radiographs were obtained from subjects who had met the study criteria were 70 samples consisting of 29 boys and 41 girls with an age range of 6-12 years. Models are grouped by gender and divided into 7 groups based on chronological age. Each tooth of the sample is calculated using the Demirjian standard. The results of this assessment are compared with chronological age and then analyzed.
Result: Results of the analysis using a paired t-test test showed significant differences ($p > 0.05$) in the Demirjian standard with an age difference is 0.35 years for boys and 0.58 years for girls (overestimation).
Conclusion: Demirjian method needs adjustment when applied to children of Javanese ethnic in the Jember region.

Keywords: demirjian method, chronological age, dental age

Introduction

Dental age is one of the best indicators for evaluating a child's development [1,2] and is believed to have little variation concerning chronological age [3]. Dental age can also be used to measure the maturation of children's teeth [4] because it is related to the formation, development, and eruption of their teeth [5].
Tooth maturation is a complex series of events from initial tooth mineralization, crown formation, root growth, tooth eruption into the oral cavity, and root apex maturation [6]. Dental maturity has an important role in estimating a person's chronological age because it has low variation [7]. The maturation of the teeth can be determined from the stage of eruption or calcification of the teeth. Dental calcification is a very clear picture in determining the maturation of the teeth. Calcification of permanent teeth itself is not affected by premature loss of primary teeth [8], ankylosis, or size deficiency of permanent teeth [9]. The appearance of dental calcification can be observed on radiographs. This method will provide a more accurate estimate of the age of the teeth [10].
Dental age can be used to determine the age of a victim who died due to an accident, or a crime caused by a natural disaster. Estimation of the age of a person using dental equipment is often done because teeth are the biological material that is most resistant to environmental changes. Of all the hard tissues found in the human body, teeth have the advantage of being stable and not easily damaged in storage. Several factors influence the estimation of individual dental age. These factors lead to variations in the estimates of dental age between individuals. Genetics is one of the most influential factors in the variation in the time and speed of tooth development. Other factors such as age, gender, race, and ethnicity also influence the prediction of individual dental age. In addition, there are also non-genetic and environmental factors that are thought to influence tooth development even though the effect is small [11].
Dental age estimation aims to provide data in the field of dentistry with an accurate dental age range. If the tooth age range is too large, it will not help accurately estimate the tooth age within a certain tooth age range. To get

the right value, the method used must have the lowest possible standard deviation and be validated in a specific population group of an individual [12].

The Demirjian method is the most commonly used dental age estimation method. This method is considered easier and more accurate because it uses indicators of tooth maturity, namely the stages of formation of permanent teeth from crown formation to root closure through panoramic radiographs. The use of the Demirjian method in several countries with different ethnic/racial results varies widely [12]. Therefore, it is recommended to make adjustments in giving maturation scores for each stage of dental calcification when using this method in different populations [13].

There are still very few references regarding the use of the Demirjian method in Indonesia, especially in Jember, so it is necessary to conduct research on the use of the Demirjian method on javanese ethnic children, especially in the Jember area.

Materials and methode

Criteria and sample size

This research is descriptive analytic research. The research sample was panoramic radiographs from patients who came to the Dental Hospital of Jember University. These patients have the following criteria: boys and girls aged 6-12 years, come from Javanese ethnicity up to 2 generations above, born and domiciled in Jember Regency, have no history such as systemic disease, hormonal disorders, premature birth, hormonal disorders congenital, radiotherapy and chemotherapy. The panoramic radiograph is of good quality and the number of complete left mandibular permanent teeth. The sample size obtained was 70 samples consisting of 29 male samples and 41 female samples with an age range from 6.00 years to 12.99 years.

Use of the Demirjian Method

The Demirjian method is a method of estimating dental age based on the stages of development of 7 left mandibular permanent teeth through panoramic X-rays. Panoramic X-rays are used because they are easier to apply to children than periapical X-rays, they are faster, and relatively safe because of low radiation and small distortion [14]. Demirjian's method is based on simplified chronological age estimation by limiting the number of stages of tooth development to eight stages and scoring them from "A" to "H". The eight stages represent the calcification of each tooth, starting from the calcification of the crown and root to the closure of the tooth apex. Demirjian used dental assessments which were converted into scores using tables for boys and girls respectively. All scores for each tooth are summed and a maturation score is calculated. The maturation score was then converted directly into dental age using published conversion tables. Each stage of maturation for the 7 left mandibular teeth has a different assessment weight [13].

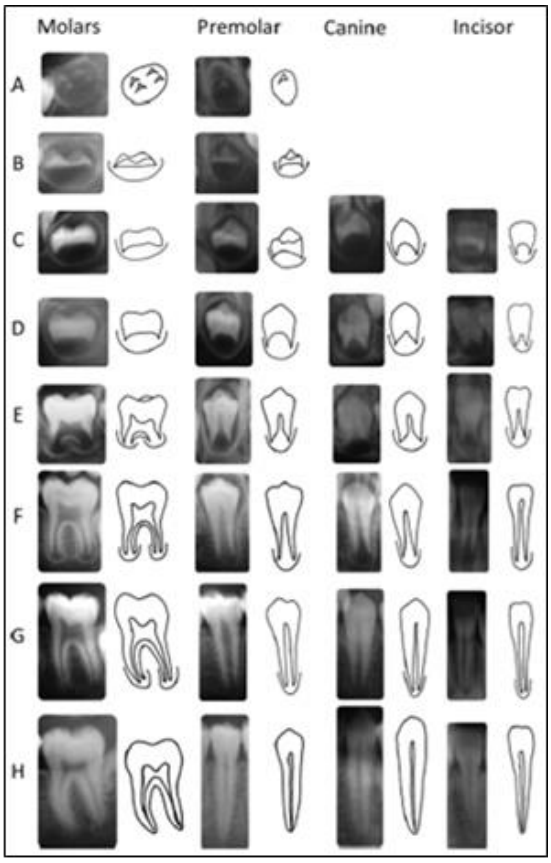

Fig 1: Stages of calcification of permanent teeth [13]

Dental Maturity Assessment

All sample assessments were carried out based on predetermined criteria. The research sample was grouped based on gender and chronological age. Chronological ages are divided into 7 age groups, namely 6-6.99 years, 7-7.99 years, 8-8.99 years, 9-9.99 years, 10-10.99 years, 11-11.99 years, and 12-12.99 years. Scoring of each sample was given to the seven lower left teeth based on the interpretation of the maturation level of the calcification stages of each tooth. Each sample was checked by the researchers themselves by carrying out 2x calculations within 2 weeks for calibration [15].

Data analysis

The data obtained from the dental age assessment were analyzed using the Paired t-test with the SPSS version 20 program to test the significance of the comparison of chronological age and dental age.

Result

The research results of assessing dental age in a sample of Javanese ethnic children in Jember using the Demirjian and Blenkin standards along with the results of the statistical analysis are presented in the form of data graphs and tables below.

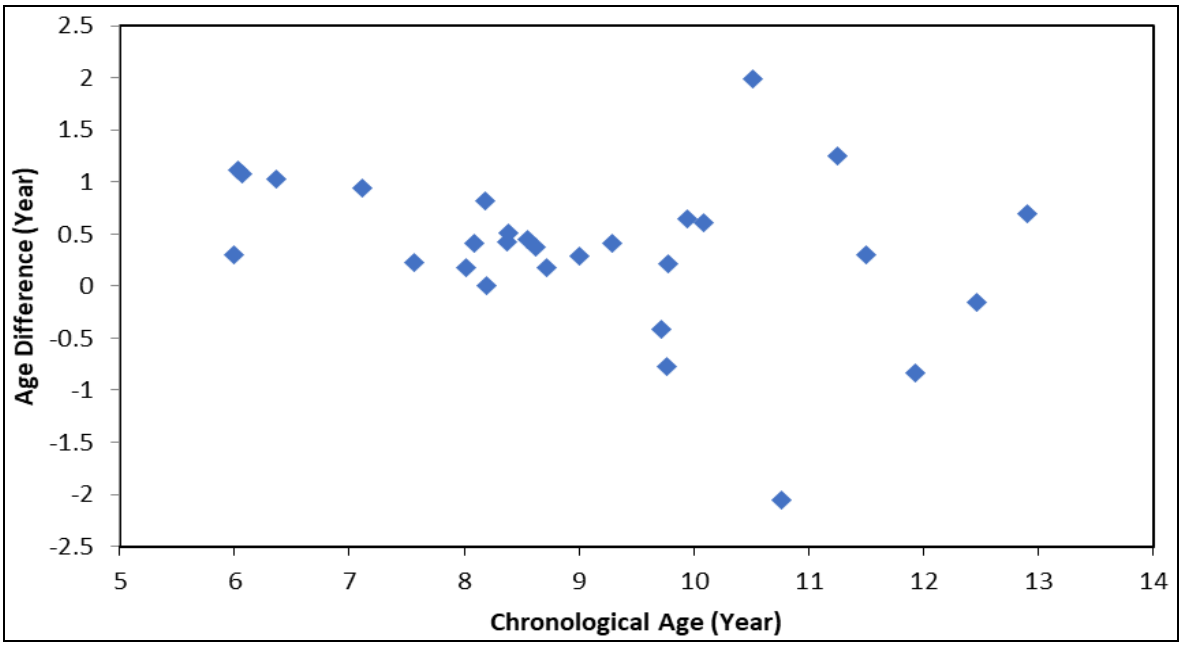

Fig 2: Diestribution of age difference between chronological age and dental age in a sample of boys

Figure 2 shows the distribution of the age difference between chronological age and dental age in a sample of male children using the Demirjian standard. Most of the values indicated an overestimation of the dental age of the chronological age for all age groups.

Table 1: The results of the t-test between chronological age and dental age in a sample of boys

Age Group		**Avergae (±SD)**			**95 % CI**	**Value p†**
Category	n	Chronological age	Dental Age	Age difference		
6-6,99	4	6,12 (0,17)	7,00 (0,48)	0,88 (0,39)	0,26; 1,50	0,020*
7-7,99	2	7,34 (0,32)	7,92 (0,18)	0,58 (0,50)	-3,92; 5,09	0,347
8-8,99	9	8,35 (0,24)	8,72 (0,33)	0,37 (0,23)	0,19; 0,55	0,001*
9-9,99	6	9,59 (0,36)	9,65 (0,58)	0,06 (0,54)	-0,50; 0,63	0,786
10-10,99	3	10,45 (0,34)	10,63 (1,90)	0,18 (2,06)	-4,93; 5,29	0,894
11-11,99	3	11,56 (0,34)	11,8 (0,70)	0,24 (1,04)	-2,34; 2,82	0,728
12-12,99	2	12,68 (0,32)	12,95 (0,92)	0,26 (0,60)	-5,13; 5,66	0,645
6-12,99	29	9,08 (1,89)	9,43 (1,81)	0,35 (0,54)	0,07; 0,63	0,016

Description: n = number of samples
SD = standard deviation
CI = confidence interval
p† = paired t-test

Table 1 can be concluded that there is a significant difference between chronological age and dental age in a sample of boys aged 6-12.99 using the Demirjian standard with an average age difference of 0.35 (SD = 0.54) and a significance value of 0.016. There is a significant age difference in the age categories 6-6.99 and 8-8.99.

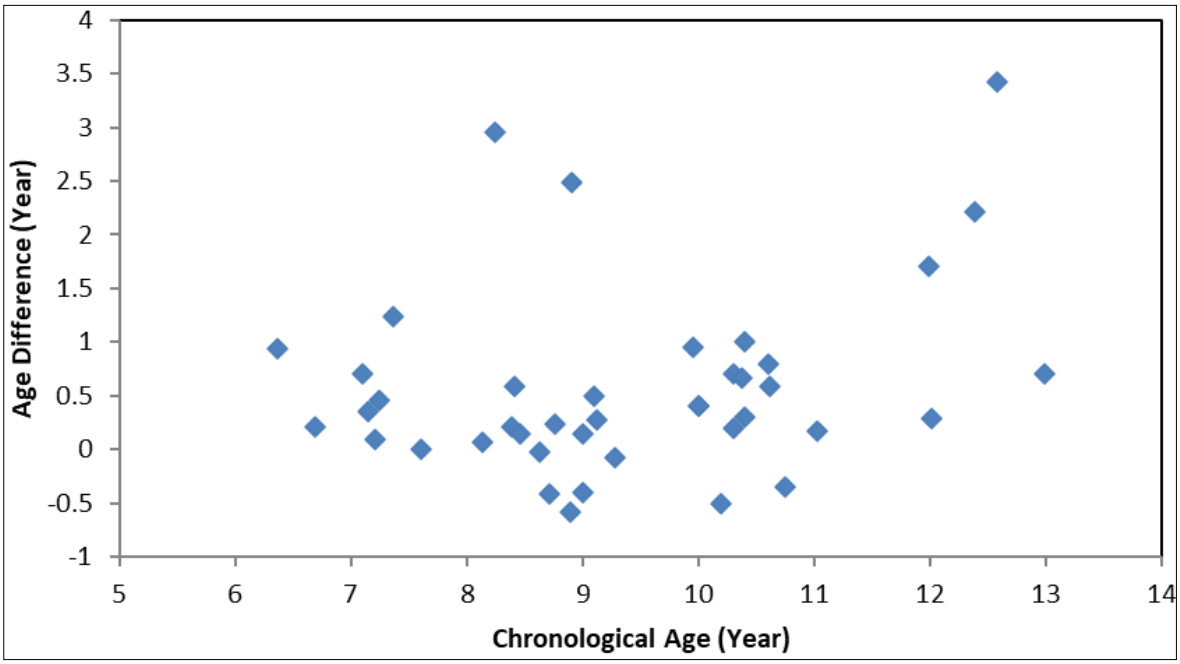

Fig 3: Distribution of age difference between chronological age and dental age in a sample of girls using the Demirjian standard

Figure 3 shows the distribution of the age difference between chronological age and dental age in a sample of girls using the Demirjian standard. Most of the values indicated an overestimation of the dental age of the chronological age for all age groups.

Table 2: Results of the t-test between chronological age and dental age in girls using the Demirjian standard

Age Group		Average (±SD)			95 % CI	Value p†
Category	n	Chronological age	Dental age	Age difference		
6-6,99	2	6,52 (0,23)	7,10 (0,28)	0,57 (0,52)	-4,06; 5,21	0,360
7-7,99	6	7,28 (0,18)	7,75 (0,45)	0,47 (0,45)	-0,01; 0,94	0,051
8-8,99	10	8,55 (0,27)	9,12 (1,18)	0,57 (1,19)	-0,28; 1,41	0,166
9-9,99	6	9,24 (0,36)	9,47 (0,77)	0,23 (0,47)	-0,23; 0,74	0,233
10-10,99	11	10,36 (0,24)	10,74 (0,52)	0,38 (0,46)	0,47; 0,85	0,000*
11-11,99	2	11,51 (0,68)	12,45 (1,77)	0,94 (1,09)	-8,84; 10,72	0,437
12-12,99	4	12,49 (0,41)	14,15 (1,55)	1,66 (1,43)	-4,06; 5,21	0,360
6-12,99	41	9,38 (1,67)	9,96 (2,08)	0,58 (0,88)	0,30; 0,85	0,000

Description: n = number of samples
SD = standard deviation
CI = confidence interval
p† = paired t-test

Table 2 can be concluded that there is a significant difference in the assessment of dental age in a sample of girls aged 6-12.99 using the Demirjian standard with an average age difference of 0.58 (SD = 0.88) and a significance value of 0.000. There is a significant age difference in the 10-10.99 age category.

Discussion

Demirjian suggests adjustments if the Demirjian method is used in different populations to obtain accurate dental age estimates. Most researchers make adjustments in the form of changing the weight of the maturation value for each tooth and creating a regression model based on each population [11].

In this study, the age difference was 0.35 years for boys and 0.58 years for girls. The age difference in this study is by several previous studies [16,17,18]. This age difference shows that the dental age of Javanese ethnic children is faster than their chronological age. Researchers argue that the large discrepancy in this study indicates the need for adjustments to the use of the Demirjian standard in the population of ethnic Javanese children.

In this study, the use of the Demirjian standard obtained a large age difference in the 6-year-old group in the sample of boys and the 10-year-old group in the sample of girls. This is by a study conducted by Leurs *et al.* which showed the largest age difference in the 5–10-year age group [16].

The large age difference indicates that there is an accelerated maturation of the teeth in this age group period. The accelerated maturation of teeth that occurs in children aged 6-12 years is often closely associated with the growth spurt process. The growth spurt process causes a high spike in tooth age in one age period. The variation in the difference in the age of the teeth is also often associated with puberty where the hormonal conditions fluctuate so that the growth of the teeth becomes unstable and not uniform [19,20].

The large age difference at 6 years (boys) and 10 years (girls) indicates a large variation in dental maturation among individuals within the Javanese ethnic population in Jember. Variations in tooth maturation between individuals are often associated with genetic factors [11]. The magnitude of genetic control among individuals not only causes variation within homogeneous populations but also between populations [21]. The Javanese ethnic population belonging to the Malayan-Mongoloid sub-race [22] has different dental growth characteristics from the French-Canadian population, which is a mixture of Native American Indians and immigrants from Europe. Therefore, it is important to understand the origin of the existence of a population in researching the dental maturation of a population [21].

Another possible factor related to variations in dental maturation is socioeconomic conditions. Socio-economic conditions which include employment and education of the parents of the research sample are often associated with variations in dental development. In high socioeconomic conditions, earlier dental development occurs than in low socioeconomic conditions, this is due to adequate nutritional intake and awareness to get better dental health care [23,24].

In addition to the factors described in the paragraph above, there are also environmental factors that can affect the tooth maturation process. Differences in climatic conditions, geographical location, temperature, and humidity of an area can cause variations in tooth maturation [21] although these factors are often related to other factors such as nutrition [11]. There is a difference in climate between the Montreal-Canada area and the Jember-Indonesia area, it may have a role in causing variations in tooth maturation. Climate, temperature, and humidity can change the development time and adaptation of certain body parts which have a role in maintaining the body's homeostatic processes [25] and produce variations in the growth of a population/ethnicity [21].

Conclusion

From the results and discussion above, it can be concluded that the application of the Demirjian method to ethnic Javanese children in Jember Regency resulted in an overestimation of dental age, namely 0.35 years for the sample of boys and 0.58 years for the sample of girls. Therefore, an adjustment is needed if the Demirjian method is applied to javanese ethnic children in Jember.

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