The Differential Pattern in Skeletal-Dental Age and Duration of Growth Spurt based on Chronological Age and Gender Types (A Comparison Study Between Indonesian and Malaysian Children Populiations)

by Seno Pradopo

The Differential Pattern in Skeletal-Dental Age and Duration of Growth Spurt based on Chronological Age and Gender Types (A Comparison Study Between Indonesian and Malaysian Children Populations)

Seno Pradopo[1], Sindy Cornelia Nelwan[2], Ardianti Maartrina Dewi[2], Amalia Wimarizky[3], Achmad Nadian Permana[3], Diana Md Zahid[4], Syiral Mastura Abdullah[4]

[1]Professor, [2]Lecturer, [3]Resident, Departement of Pediatric Dentistry, Faculty of Dental Medicine Universitas Airlangga, Surabaya-Indonesia, [4]Lecturer, Department of Orthodontik, Fakulti Pergigian, Universitas Sains Islam Malaysia

Abstract

Context: Growth and development is a continuous process that occurs intrauterine and continues until adulthood. In the process of reaching adulthood, children must go through various stages of growth and development, Growth is influenced by two main factors, namely internal (genetic) factors and external (environmental) factors. Internal factors include gender, obstetrics and race or ethnicity. Based on the background pattern above, the researcher wants to compare the difference in the duration of growth spurt between the Malaysian and Indonesian populations in terms of the Cervical Vertebrae Maturation (CVM) seen on the lateral cefalogram

Aims: to compare the differences in the duration of growth spurt between girl and boy in Indonesian and Malaysia Population based on Cervical Vertebrae Maturation (CVM) seen in the lateral cephalogram to determine the right time and orthodontic treatment plan in order to get maximum treatment results.

Methods and Material: The study was conducted in June 2020. The research variables were divided into 3 types, namely independent variables (chronological age), dependent variables (skeletal age and growth spurt duration) and controlled variables (Indonesian population children, Gender, CVM CS3 - CS4). Every sample that met the criteria was performed skeletal maturity analysis using Cervical Vertebrae Maturation.

Results: The boy sample required a duration of age to reach maturity, 17.93 months in Indonesia and 17.91 months in Malaysia. Meanwhile, the girs sample only required the duration of growth spurt, namely 6.59 months in Indonesia and 6.64 months in Malaysia

Conclusion: There is no significant difference between the duration of growth spurt in Indonesian Boy and Malaysian Boy and so does the duration of growth spurt for Indonesian and Malaysian girl.

Keywords : Cervical vertebrae maturation; Growth Spurt; Indonesian; Malaysian

Corresponding Author:
Seno Pradopo
Jl Prof Dr Moestopo No 47 Surabaya
Phone numbers :- Facsimile numbers
E-mail address : seno-p@fkg.unair.ac.id

Introduction

The period of growth and development is a period of various changes, including in the oral cavity. Evidence of growth and development is the process

of replacing primary teeth with permanent teeth. Growth and development is a continuous process that occurs intrauterine and continues until adulthood. In the process of reaching adulthood, children must go through various stages of growth and development, including the adolescent stage. The adolescent stage is a transitional period between childhood and adulthood which begins with the maturation of the physical (sexual) organs so that they are able to reproduce, secondary sex characteristics arise, increased height and weight, skeletal growth accompanied by an increase in bone mass, changes in body composition, and psychological and cognitive changes [1]

The right time to treat class II malocclusion is when the growth spurt occurs and class III malocclusion treatment occurs before and during the growth spurt[2]The peak of growth (growth spurt) is the time of the fastest growth followed by slower growth[14]. All children will go through a growth spurt in early adolescence which is clearly visible with changes in height and weight[3.]The occurrence of growth spurt depends on sex and varies with each chronological age. This variation determines the speed as well as the duration of the growth process. Growth spurt in women occurs at the age of 10 to 12 years, while in men aged 12 to 14 years[4]. pubertal growth spurt in women on average occurs at the age of 12 years, while in men at the age of 14 years[5]. Knowledge of when this growth spurt occurs can determine a person's morphological and dimensional end, namely by utilizing their growth potential and maturity[2]

Growth is influenced by two main factors, namely internal (genetic) factors and external (environmental) factors. Internal factors include gender, obstetrics and race or ethnicity. If these factors can interact in a good and optimal environment, it will result in optimal growth as well.

Socio-economic factors that affect children's growth include: education, employment, technology, culture and family income. These factors will interact with one another so that it can affect the intake of nutrients and infection in children. The availability of nutrients at a low cellular level which in turn will result in disrupted growth[4].

Based on the background pattern above, the researcher wants to compare the difference in the duration of growth spurt between the Malaysian and Indonesian populations in terms of the Cervical Vertebrae Maturation (CVM) seen on the lateral cefalogram. This information is important for determining the right time and orthodontic treatment plan in order to get maximum treatment results.

Subjects and Methods

This research was conducted as an observational analytic study with a cross-sectional study design. The sample used in this study was the patient of RSGM FKG UNAIR (Universitas Airlangga Dental Hospital), Surabaya-Indonesia, and Universiti Sains Islam Malaysia (USIM), Nilai-Malaysia- . Sample data was collected by inclusively selected in children criteria as follow: aged 8-18 years, had never performed orthondontic treatment, had no history of systemic diseases that interfere with growth and bone and tooth development, have never experienced facial trauma or surgery on facial structures, have no congenital tooth abnormalities, do not have growth syndromes or anomalies from facial structures, are Javanese and are willing to do cephalometric photographs.

The sample used refers to the formula is 60.[4] This research was conducted at the Dental Hospital Airlangga University and USIM dental hospital. The study was conducted in June 2020. The research variables were divided into 3 types, namely independent variables (chronological age), dependent variables (skeletal age, tooth age and growth spurt duration) and controlled variables (Indonesian population children, Gender, CVM CS3 - CS4). Every sample that met the criteria was performed skeletal maturity analysis using Cervical Vertebrae Maturation (CVM. Skeletal analysis with Cervical Vertebrae Maturation (CVM) by looking at bone maturation and defined into six categories ranging

from CS1 to CS6. Cervical Vertebrae Maturation (CVM) analysis in the CS3 and CS4 phases for chronological age was also performed. Every data that has been analyzed is recorded and grouped according to chronological age and calculates the average based on gender and race. It was also conducted to calculate the interval between groups CS3 and CS4 in each sex and race. Furthermore, to analyze differences in children growth and development patterns using those indicators between the study samples in the two countries, a discriminant analysis was carried out using SPSS version 22.

Results

For the entire sample and each individual group, a linear discriminant function analysis was used to discriminate and display which variables allow for the best classification between the groups. Wilks'

Lambda analysis was used to identify the contribution of each variable and its significance in discriminating each group and the overall sample size. A canonical correlation analysis was then completed to determine the relationship among the variables and the discriminant function analysis. A test for normality was also conducted to determine which variables were normally distributed throughout the groups.

Each variable listed as indicators such: independent variables (chronological age), dependent variables (skeletal age, tooth age and growth spurt duration) and controlled variables (Indonesian population children, Gender, CVM CS3 - CS4) was tested for normality of data. All variables were within normal (p>.05) limits. All variables resulted in a 95% confidence interval with mean values falling between the upper and lower bounds. Here are the distribution analysis:

Table 1. Average age of children (overall) in Indonesia and Malaysia based on cervical vertebra maturity level.

Country	Cervical vertebra maturity level (CVMS)	Mean Age ± SD	n	%
Indonesia	CVMS 3	127,40 ± 19,175	48	51,62 %
	CVMS 4	139,18 ± 25,693	45	48,38 %
Malaysia	CVMS 3	173,29 ± 24,395	34	56,66 %
	CVMS 4	185,08 ±25,887	26	43,34 %

The peak of growth (growth spurt) is the time of the fastest growth followed by slower growth[14]. All children will go through a growth spurt in early adolescence which is clearly visible with changes in height and weight[2]. The occurrence of growth spurt depends on sex and varies with each chronological age. This variation determines the speed as well as the duration of the growth process. Growth spurt in women occurs at the age of 10 to 12 years, while in

men aged 12 to 14 years. Pubertal growth spurt in women on average occurs at the age of 12 years, while in men at the age of 14 years[14]. Knowledge of when this growth spurt occurs can determine a person's morphological and dimensional end, namely by utilizing their growth potential and maturity[13]. This information is important to determine the right time and orthodontic treatment plan for children in order to get maximum treatment results.

Referring to the results of these previous studies, it is illustrated that in general, the duration of growth spurt in men tends to take longer than women. In this study, this tendency also has the same pattern, namely the duration of growth spurt in boys has a longer period when compared to girls.

Table 2. Average age of children (boys and girls) in Indonesia and Malaysia based on the maturity level of the cervical vertebrae.

Country	Cervical vertebra maturity level (CVMS)	Gender	Mean Age ± SD	n	%
Indonesia	CVMS 3	Boys	134,36 ± 18,303	25	52,08 %
		Girls	119,83 ± 17,466	23	48,92 %
	CVMS 4	Boys	140,95 ± 23,230	20	44,44 %
		Girls	137,76 ± 27,899	25	55,56 %
Malaysia	CVMS 3	Boys	170,82 ± 27,992	17	50 %
		Girls	175,76 ± 20,759	17	50 %
	CVMS 4	Boys	188,73 ± 30,401	11	42,31 %
		Girls	182,40 ± 22,768	15	57,69 %

Table 3. One Sample Kolmogorov Smirnov Test Results (Normality) Age between boys and girls in both countries

Country	Gender	n	Nilai p (Sig.)
Indonesia	Boys	45	0,066
	Girls	48	
Malaysia	Boys	28	
	Girls	32	

Table 4. Mean increased value in duration of growth spurt (CVMS) between boys and girls in both countries

Country	Cervical vertebra maturity level (CVMS)	Gender	Mean Age ± SD	n	%	p value
Indonesia	CVMS 3 – CVMS 4	Boys	17,93 ± 10,433	45	48,38 %	0.860
Malaysia			17.91± 2,409	48	51,62 %	
Indonesia		Girls	6,59 ± 4,93	28	46,66 %	0.583
Malaysia			6,64 ± 2,009	32	53,34 %	

Table 5. Description of the difference in the duration of cervical vertebral maturation (CVMS) of boys between the two countries

Country	Cervical vertebra maturity level (CVMS)	Gender	Mean Age ± SD	n	%	P Value
Indonesia	CVMS 3	Boys	134,36 ± 18,303	25	55,56	,000
Malaysia			170,82 ± 27,992	17	60,71	
Indonesia	CVMS 4		141,26 ± 23,823	20	44,44	,000
Malaysia			188,73 ± 30,401	11	39,29	

In the cervical vertebrae maturation duration status (CVMS) with a CVMS level of 3, the cases analyzed were 40 respondents. 23 respondents were recorded as data for boys from Indonesia and 17 respondents were recorded as data for boys from Malaysia. The mean duration of cervical vertebrae maturation (CVMS) in the MAS - Boys (Malaysia) variable was 170.82, while the INA - Boys (Indonesia) variable was 119.83. In the cervical vertebrae maturation duration status (CVMS) with a CVMS level of 4, the cases analyzed were 36 respondents. 25 respondents were recorded as data for boys from Indonesia and 11 respondents were recorded as data for boys from Malaysia. The mean duration of cervical vertebrae maturation (CVMS) in the MAS - Boys (Malaysia) variable was 188.73, while the INA - Boys (Indonesia) variable group was at 137.76. The significance value of the mean duration of cervical vertebrae maturation (CVMS) 3 and 4 in the samples in the two countries above is at a sig <0.05 (0.000).

Discussion

The growth and development period is the period in which various changes occur, including in the oral cavity. Evidence of growth and development is the process of replacing deciduous teeth with permanent teeth. Growth and development is a continuous process that occurs from intrauterine and continues into adulthood. Human growth consists of periods of accelerated growth where accelerated growth is followed by periods of slower growth. The time of accelerated puberty growth and the maximum speed of growth during this developmental phase differ in boys and girls, and also vary at each chronological age. Identification of periods of individual growth acceleration is important in orthodontic treatment because growth modification is best achieved during periods of accelerated adolescent (pubertal) growth.

Growth and development can be assessed through several parameters such as chronilogical age, increase in body weight and height, characteristics of sexual maturation, tooth maturation, skeletal maturation. Chronological age is the clearest and easiest method of calculating developmental age which can be seen through the child's birth date, but is not an accurate indicator of developmental levels. Skeletal age is determined by looking at skeletal maturity which refers to the level of development of ossification in the bone. The CVMS (Cervical Vertebrae Maturation Stage) method has proven to be clinically effective can be used to assess the growth of the mandible during a child's growth. CVMS is an assessment of the level of cervical vertebrae maturation based on the shape and size of the 2, 3, and 4 cervical vertebrae. Indicators used in cervical vertebral radiographic analysis can be seen from the hollowness of the lower edge of the corpus, corpus height and shape of the cervical vertebra.

The Malay race is the largest racial group found in Indonesia as well as Malaysia. This group is divided into the Old Malay race (Proto Melayu) and the Young Malay race (Deutero Melayu). Based on

this racial pattern, the population of Malaysia and Indonesia were further defined into the same sub-race, namely the Malayan-Mongoloid sub-race. This sub-race has physical characteristics such as straight to wavy black hair, large eyes and olive to brownish skin. Its distribution includes Malaysia, Singapore, Indonesia, Brunei Darussalam and the Philippines. Race is one of the factors that can affect growth, this can be seen from the different facial types between the existing races. The same racial group will show the same craniofacial growth patterns so that they have a tendency to have similar skull and jaw shape patterns, although this kind of pattern is also influenced by individual variation[1].

Patterns of growth and development of children are reflected in height and can vary between races, sexes and ages. The variation in height between races can be seen from, for example, differences in the mean height of the Caucasians and Mongoloid races[2]. This can be due to genetic variation between races. In this study, the races that were the research subjects in both countries (Malaysia and Indonesia) came from the same race, namely the Mongoloid race (Deutero-Malay), thus implying that there are similarities in the growth and development patterns experienced by children in both countries[4]

On the other hand, differences in the geographic location of a country could theoretically affect this variation. Differences in growth and development patterns can also vary according to gender because they are influenced by the presence of sex hormones. After puberty, androgens and estrogens also play a role in growth. This could explain why the growth spurt in adolescent girls occurs earlier than in boys. Differences according to age can be caused because height growth occurs linearly from bottom to top, therefore height increase will be directly proportional to age increase. The growth rate of each age group varies. This is due to a growth spurt at certain ages[1]. This study will discuss whether the interaction of confounding variables such as geographic differences in countries and the influence of sex hormones

on different sexes is able to show differences or similarities in child development patterns in terms of growth spurt speed seen from The CVM analysis.

Recently, a series of investigations performed in different parts of the world have confirmed the validity of the cervical vertebral maturation (CVM) method, mostly by comparing it with the hand and wrist method[11]The CVM hgs proved to be effective to assess the adolescent growth peak in both body height and mandibular. The ossification events in the cervical vertebrae begin during fetal life and continue until adulthood. Therefore, maturational changes can be observed in the vertebrae during this interval, which covers the period when orthodontic treatment is typically performed in the growing patient.

From Table 5 data, it is concluded that the mean duration of cervical vertebrae maturation (CVMS) level 3 in the MAS - Boys (Malaysia) variable is higher than the INA - Boys (Indonesia) variable group. Furthermore, the mean duration of cervical vertebrae maturation (CVMS) level 4 in the MAS - Boys (Malaysia) variable is also higher than the INA - Boys (Indonesia) variable group. According to the comparison analysis, there is a significant difference in the mean duration of cervical vertebrae maturation (CVMS) 3 and 4 between the variable MAS - Boys (Malaysia) and the variable INA - Boys (Indonesia). Due to the significance value of the Wilk's Lambda Test by 0.000 (<0.05), it can be concluded that in each country, boys have significantly different cervical vertebral maturation (CVMS) duration for boys, both at CVMS level 3 or 4.

According to the published data, mean chronological age at menarche for Tehranian females is reported from 12 years to 12.6 years.Therefore, it can be concluded that the peak of the growth spurt occurs at 11-11.5 years of age in named population. The mean chronological age at pre-pubertal stages (CS3 and CS4), in this study, was 11.48 years, which is very close to calculated age of the growth spurt. In other words, the time interval between the age at

peak skeletal growth and the average age of the first menstruation is about 6-12 months in these subjects that seem logical.[6]

The growth to adult shape and size is controlled by more than one gene, each gene having small effect. It is difficult to spot any single gene that determine morphological characteristic. For example, the genetic factors influencing bone mass will be different from the genetic factors that control skeletal growth, which all contributes to the child's weight.

From table 4, we could tell that duration of growth spurt between Indonesian and Malaysia on boys and girls, there are no significant differences. It causes, Malaysia and Indonesia has same race, Melanesia. Indonesia and Malaysia are two countries not only because of location geographic as a neighbor but has a diversity of cultures that almost the same. The one that differs Indonesia and Malaysia, that Malaysia has cultural diversity supported by skills that can drive the communication process effective. This cannot be separated from the role ethnic Malaysian origin, namely Ethnic Malays. In Malaysia, there are many cultural like chineese, indian, ethnic malays itself. From this data, we thought the data was taken from ethnic Malay because ethnic malays has many similarities with Indonesian people.

Ethical Clearance- Taken from faculty of dental medicine airlangga university committee

Source of Funding- Funding from Airlangga University

Conflict of Interest - Niil

References

1. Soetjiningsih, 2004. Buku Ajar: Tumbuh Kembang Remaja dan Permasalahannya. Jakarta. 2004. .Sagung Seto

2. Proffit WR. Concepts of growth and development. In: Proffit WR, Fields HW, Sarver DM, Ackerman JL, eds. Contemporary orthodontics. 5 ed. 2011. P.355

3. Brook, Charles., Peter Clayton, Rosalind Brawn (ed). Brook's Clinical. dalam: Batubara JRL, Tridjaja B, Pulungan A, penyunting. Buku Ajar Endokrinologi Anak. Edisi ke-1. Jakarta: Badan Penerbit Ikatan Dokter Anak Indonesia. 2009. p.19-42.

4. Goodman, H Maurice. Basic Medical Endocrinology 4th edition. California USA: Elsevier Polak,Michel., Jo Blair, Primoz Kotnik, Effie Pournara, Birgitte Tønnes Pedersen, Tilman R Rohrer. 2017. Early growth hormone treatment start in childhood growth hormone deficiency improves near adult height: analysis from NordiNet® International Outcome Study. European Society of Endocrinology

5. Ewa Wajs-Kuto, Lieve Op De Beeck, Raoul PA Rooman and Marc V L Du Caju. Hormonal changes during the first year of oestrogen treatment in constitutionally tall girls. European Journal of Endocrinology. 1999. 141 p. 579–584

6. Ross, Judith L., Peter A Lee, Robert Gut, John Germak. *Increased height standard deviation scores in response to growth hormone therapy to near-adult height in older children with delayed skeletal maturation: results from th ANSWER Program.* International Journal of Pediatric Endocrinology. 2015. P.105

7. Pichai, Saravanan & Rajesh, M & Admala, Naveen & Adusumilli, Gopinath & Reddy, Jayaprakash & Joshi, BhavanaA Comparison of Hand Wrist Bone Analysis with Two Different Cervical Vertebral Analysis in Measuring Skeletal Maturation. Journal of international oral health : JIOH. (2014). 6. 36-41.

8. Safavi SM, Beikaii H, Hassanizadeh R, Younessian F, Baghban AA. Correlation between cervical vertebral maturation and chronological age in a group of Iranian females. Dent Res J 2015;12:443-8.

9. Heijden, Perry & Korsten, Astrid & Laan, Bernard & Wit, Hero & Goorhuis-Brouwer, Sieneke. (2009). Nasal Growth and Maturation Age in Adolescents. Archives of otolaryngology--head & neck surgery. 134. 1288-93. 10.1001/archoto.2008.501.

10. Gandini P, Mancini M, Andreani F. A comparison of hand-wrist bone and cervical vertebral analyses in measuring skeletal maturation. Angle Orthod. 2006;76:984-989.

11. Hägg U, Taranger J. Menarche and voice change as indicators of the pubertal growth spurt. Acta Odontol Scand. 1980;38:179-186.

12. Manna I. Growth development and maturity in children and adolescent: relation to sports and physical activity. American J Sports Sci Med. 2014; 2(5A): 48-50. doi: 10.12691/ajssm-2-5A-11

13. Hassel B, Farman AG. Skeletal maturation evaluation using cervi- cal vertebrae. Am J Orthod Dentofac Orthop. 1995;107:58-66.

14. Mitchell L. An introduction to orthodontics. 3 ed. New York: Oxford University Press; 2007. p. 34.

The Differential Pattern in Skeletal-Dental Age and Duration of Growth Spurt based on Chronological Age and Gender Types (A Comparison Study Between Indonesian and Malaysian Children Populiations)

7 Małgorzata Kuc-Michalska, Tiziano Baccetti. "Duration of the Pubertal Peak in Skeletal Class I and Class III Subjects", The Angle Orthodontist, 2010
Publication

1%

8 Natasha Patil, Neha Maheshwari, Rohit Sharma, Shashank Soni, Ashish Kushwah. "Correlation between Chronological Age, Cervical Vertebral Maturation and Fishman's Skeletal Maturity Indicators in Central India Population", Orthodontic Journal of Nepal, 2019
Publication

<1%

9 repository.uki.ac.id
Internet Source

<1%

10 worldwidescience.org
Internet Source

<1%

11 www.ijfmt.com
Internet Source

<1%

12 ijms.sums.ac.ir
Internet Source

<1%

13 ispcd.org
Internet Source

<1%

14 Agnieszka Szemraj-Folmer, Anna Wojtaszek-Słomińska, Bogna Racka-Pilszak, Małgorzata Kuc-Michalska. "Duration of the pubertal

<1%

growth spurt in patients with increased craniofacial growth component in sagittal and vertical planes—retrospective and cross-sectional study", Clinical Oral Investigations, 2021
Publication

15 Mártha I. Krisztina, Ogodescu A, Gyergyay Réka, Burján Zsuzsa. "Evaluation of the Skeletal Maturation Using Lower First Premolar Mineralisation", Acta Medica Marisiensis, 2013
Publication

<1 %

16 Eddie Hsiang-Hua Lai, Jen-Pei Liu, Jenny Zwei-Chieng Chang, Shih-Jaw Tsai et al. "Radiographic Assessment of Skeletal Maturation Stages for Orthodontic Patients: Hand-wrist Bones or Cervical Vertebrae?", Journal of the Formosan Medical Association, 2008
Publication

<1 %

17 thejcdp.com
Internet Source

<1 %

18 www.thejcdp.com
Internet Source

<1 %

19 Saverio Padalino, Maria Francesca Sfondrini, Laura Chenuil, Luigia Scudeller, Paola Gandini. "Reliability of skeletal maturity analysis using the cervical vertebrae maturation method on

dedicated software", International Orthodontics, 2014
Publication

20 Samantha Kimball, Ghada El-Hajj Fuleihan, Reinhold Vieth. "Vitamin D: A Growing Perspective", Critical Reviews in Clinical Laboratory Sciences, 2008
Publication

<1 %

Exclude quotes   On   Exclude matches   Off
Exclude bibliography   On

The Differential Pattern in Skeletal-Dental Age and Duration of Growth Spurt based on Chronological Age and Gender Types (A Comparison Study Between Indonesian and Malaysian Children Populiations)

FINAL GRADE

/100

GENERAL COMMENTS

Instructor