

RESEARCH ARTICLE

Evaluation of Cephalometric Downs Analysis on Cephalograms at RSGM YARSI, Jakarta

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Abstract

Introduction: Cephalometric analysis is used to help establish a diagnosis and treatment plan in orthodontics. One of the cephalometric analysis is the Downs analysis which is measured in Caucasians and has its standard values. However, these values cannot be applied to other races and ethnicities because there are variations based on racial and ethnic groups. Therefore, it's necessary to know the average value of Downs analysis for Indonesians. **Objective:** This study aimed to evaluate Downs analysis on cephalograms at RSGM YARSI Jakarta, compare it with Downs' norms and other ethnicities, and determine differences between gender. **Materials and Methods:** Measurements of 10 parameters of Downs analysis were carried out on 29 cephalograms that met the inclusion criteria Data were tested with SPSS using one sample t-test. **Results:** The mean of the facial angle are $85.17^{\circ} \pm 3.07$; angle of convexity $3.62^{\circ} \pm 2.79$; AB plane angle AB $-2.65^{\circ} \pm 2.55$; mandibular plane angle $29.82^{\circ} \pm 3.37$; Y-axis $64.15^{\circ} \pm 3.34$; occlusal plane angle $11^{\circ} \pm 2.86$; interincisal angle $113.06^{\circ} \pm 7.64$; LI-occlusal angle $28.41^{\circ} \pm 5.24$; IMPA angle $10.24^{\circ} \pm 5.76$; distance of UI-APog $8.05 \text{ mm} \pm 1.85$. **Discussion:** The RSGM YARSI cephalometric value compared to the Downs' norms shows that the chin towards the FHP is more retroposition, the face is more convex, the relationship of the lower and upper jaw to the NPog is more protrusive, the direction mandibular growth towards the FHP is more vertical, the direction of facial growth is more downward, occlusal growth towards the FHP is steeper, and the incisors are more protruded. The direction of growth in women is more vertical than in men, and there are differences in cephalometric values with other races. **Conclusion:** There is a significant difference between the Downs cephalometric values of RSGM YARSI and the Downs' norms in all measurements. Between men and women at RSGM there are differences in the direction of growth. There are differences in measurement values with other races.

Keywords: *Downs analysis, cephalometry, RSGM YARSI*

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Evaluasi analisis analisis sefalometri Downs pada sefalogram di RSGM Yarsi, Jakarta

Abstrak

Latar belakang: Analisis sefalometri digunakan untuk membantu menegakkan diagnosis dan rencana perawatan dalam ortodonsia. Salah satu analisis sefalometri adalah analisis Downs yang diukur pada ras Kaukasia dan terdapat nilai standardnya. Namun nilai ini tidak dapat diterapkan pada ras dan etnis lain karena adanya variasi berdasar kelompok ras dan etnis. Karena itu perlu diketahui nilai rata-rata analisis Downs untuk orang Indonesia. **Tujuan:** Penelitian ini bertujuan untuk mengevaluasi nilai analisis Downs pada sefalogram yang terdapat di RSGM YARSI Jakarta, membandingkannya dengan nilai standard Downs dan etnis lainnya, serta mengetahui adanya perbedaan antara laki-laki dan perempuan. **Bahan dan Metode:** Pengukuran 10 parameter pada analisis Downs dilakukan pada 29 sefalogram yang memenuhi kriteria inklusi. Data diuji menggunakan SPSS dengan one sample t-test. **Hasil penelitian:** Besar rata-rata sudut fasial $85,17^{\circ} \pm 3,06$; sudut konveksivitas $3,62^{\circ} \pm 2,79$; sudut bidang AB $-2,65^{\circ} \pm 2,55$; sudut bidang mandibula $29,82^{\circ} \pm 3,37$; sumbu Y $64,15^{\circ} \pm 3,34$; sudut bidang oklusal $11^{\circ} \pm 2,86$; sudut interinsisal $113,06^{\circ} \pm 7,64$; sudut LI-oklusal $28,41^{\circ} \pm 5,24$; sudut IMPA $10,24^{\circ} \pm 5,76$; jarak UI-APog $8,14 \text{ mm} \pm 1,74$. **Diskusi:** Nilai sefalometri RSGM YARSI dibandingkan nilai standard Downs menunjukkan posisi dagu terhadap FHP yang lebih retroposisi, wajah lebih cembung, hubungan rahang bawah dan rahang atas terhadap NPog lebih protrusi, arah pertumbuhan mandibula terhadap FHP lebih vertikal, arah pertumbuhan wajah lebih downward, pertumbuhan oklusal terhadap FHP lebih vertikal, dan gigi insisif lebih protrusi. Arah pertumbuhan perempuan lebih vertikal dibanding laki-laki, dan terdapat perbedaan nilai sefalometri dengan ras lain. **Kesimpulan:** Terdapat perbedaan bermakna antara nilai sefalometri analisis Downs yang didapat di RSGM YARSI dengan nilai standard Downs dalam semua pengukuran. Antara laki-laki dan perempuan di RSGM terdapat perbedaan pada arah pertumbuhan. Terdapat perbedaan nilai pengukuran dengan ras lain.

Kata Kunci : *Downs analysis, cephalometry, RSGM YARSI*

INTRODUCTION

Cephalometry is a quantitative analysis of hard and soft tissue structures on a cephalogram. Its benefit is as an aid to establish orthodontic diagnosis and treatment planning as well as evaluating the relationship of the teeth and face before, during treatment and after treatment.^{1, 2, 3} One of the cephalometric analysis methods that is widely used is Downs method (1948).⁴ Downs standard norms is determined based on subjects of the Caucasian race, so this value is not ideal to apply as an absolute value to other races and ethnicities.^{3, 5, 6, 7}

Several researchers showed significant differences between the cephalometric values of various populations compared with Downs norms. Altemus' study (1960, in Drammond 1967)⁸ on the Negro American population stated that the skeletal and incisor patterns of Negroes were more protrusive than the standard Downs value.⁸ Park's (1989)⁹ study on the Korean population found a striking difference in the convexity angle which was greater than the standard value Downs. Al-Jasseer (2005)⁶ found that the face of the Saudi Arabian population was more convex, the interincisal angle was smaller than Downs' standard value. Alam (2012)¹⁰ in the Bangedesh population and Vaid (2019)¹¹ in the Himachali Mongol population also found several differences measurement with Downs' standard values.

Most of Indonesia's population comes from the Malayan-Mongoloid and the Melanesian races. In Indonesia, study on cephalometric measurements using the Downs method has been published by Munandar (1995)⁵ on patients of the Deutro-Malay race and

Ruth (2000)¹² on Manggarai population in Flores. Munandar exhibited significant differences between Indonesians and Downs norms in the convexity angle, Y axis, and more protrusive incisor inclination. There were also differences between women and men who have more protrusive dentoalveolar structures than men. Ruth found that the faces of the Manggarai population were more convex and men's incisors were more protrusive than women's. The diversity of the population creates differences in craniofacial characteristics when compared with other ethnicities, so standard cephalometric values for the Indonesian population are very necessary.^{13, 14, 15}

The recent COVID-19 pandemic situation has made it less possible to conduct direct research on human subjects, so the research was carried out using cephalogram data at the YARSI Dental and Oral Hospital (RSGM). RSGM Yarsi is located in Central Jakarta and accepts patients from various ethnicities in Indonesia. This study aims to evaluate the Downs method of cephalometry on cephalogram samples at RSGM YARSI, in order to add data to standard cephalometric values for Indonesians, comparing them with standard Downs values and other ethnicities.

MATERIALS AND METHODS

Twenty-nine cephalograms that met the inclusion criteria at the Radiology Department of RSGM YARSI, from 2015-2020, were taken as samples. Ethical approval was obtained from Faculty of Dentistry Universitas YARSI. Inclusion criteria were age 15-40 years, years, good looking profile determined by 4 judges, class I molar relationship, complete teeth except third molar, ANB angle 2.5 ± 1.511 ¹⁴ and good cephalogram quality. All of these criteria were applied because orthodontic treatment includes aesthetic and functional. Attractive aesthetics does not always mean good ANB and good ANB does not equal to attractive aesthetics. Measurements were carried out by 1 person, and intra-examiner reliability was carried out with good result. The data obtained were compared with Downs norms and previous studies in other ethnicities.

The following were the measured data. Facial angle, namely the angle of intersection between the N-Pogonion line and the Frankfort horizontal plane (FHP). The plane angle AB is the angle of intersection between line AB and NPog. The convexity angle is the angle of intersection between NA line and APog line. Y-axis is the intersection angle between the SGn and FHP lines. The occlusal plane angle is the angle of intersection between the occlusal plane and FHP. The mandibular angle is the angle of intersection of the mandibular plane with FHP. The mandibular plane is the line connecting gonion with menton. Gonion is obtained by dividing by 2 the angles of the intersection of the line that tangents the posterior side of the mandible to the articulare point (Ar) with the line that tangent the inferior side of the mandible. Menton is obtained by drawing a line from gonion tangent the mandibular symphysis. The interincisal angle is the angle of intersection of the axes of the maxillary incisor and mandibular incisor. The I-occlusal plane angle is the angle of intersection between the occlusal plane and mandibular incisor axis. The I-MPA angle is the angle between the mandibular plane and the mandibular incisor axis. The I-APog distance is the distance between the incisal edge of the maxillary incisor to the APog line.

The cephalograms were traced manually using tracing paper and viewer, then cephalometric measurements were taken. Analytical tests to see differences in cephalometric values between men and women and between RSGM YARSI values and standard Downs norms were carried out using the independent t-test and Mann Whitney U. To assess the differences between RSGM YARSI cephalometric values and standard Downs norms were tested by one sample t-test and one sample non-parametric. Results were shown with a 95%

confidence interval, average of measurement variables, minimum and maximum values, standard deviation, with a significance level of $p < 0.05$.

RESULTS

The average values of 10 Downs parameters on the RSGM YARSI, the minimum and maximum values as well as the average values for women and men are listed in Table 1. Compared to standard Downs values, there are significant difference for all measurements with those of RSGM YARSI (Table 2, Fig. 1). The position of the chin relative to the FHP (facial angle) in the RSGM YARSI sample is more reposition (85.17°) than the Downs norm (87.8°). The RSGM YARSI sample has a more convex facial profile (convexity angle, 3.62°) than the Downs norm (0°), the relationship of the lower and upper jaw to NPog (AB plane angle) appears more protrusive (-2.65°), the direction of facial growth (MPA angle, 29.82°) is more vertical or downward (downward) than the Downs norm (21.9°). In dental measurements, the occlusal plane relative to the FHP in the RSGM YARSI sample is steeper (11°) than the Downs norm (9.3°). The interincisal angle in the RSGM YARSI sample is smaller (113.06°) so that the mandibular and maxillary incisors are more proclined compared to the Downs norm (135.4°).

Table 1. Mean of Downs cephalometric analysis, minimum and maximum, female and male values on the cephalogram at RSGM YARSI

No.	Variable	RSGM YARSI	Min	Max	Female	Male
1.	Facial angle ($^\circ$)	$85,17 \pm 3,07$	76	91	$85,20 \pm 3,24$	$85,0 \pm 2,34$
2.	Convexity angle ($^\circ$)	$3,62 \pm 2,79$	0	11	$3,29 \pm 2,72$	$5,2 \pm 2,86$
3.	AB plane angle ($^\circ$)	$-2,65 \pm 2,55$	-9	4	$-2,62 \pm 2,65$	$-2,8 \pm 2,28$
4.	MP angle ($^\circ$)	$29,82 \pm 3,37$	22	43	$30,37 \pm 3,42$	$27,2 \pm 1,3^*$
5.	Y-axis ($^\circ$)	$64,15 \pm 3,34$	59	72	$64,06 \pm 3,35$	$64,6 \pm 3,64$
6.	Occlusal plane angle ($^\circ$)	$11,00 \pm 2,86$	5	20	$11,04 \pm 3,00$	$10,8 \pm 2,38$
7.	Interincisal angle ($^\circ$)	$113,06 \pm 7,64$	94,5	127,5	$113,79 \pm 6,20$	$109,6 \pm 13,01$
8.	LI-occlusal ($^\circ$)	$28,41 \pm 5,24$	12	40	$28,29 \pm 4,05$	$29 \pm 9,87$
9.	IMPA ($^\circ$)	$10,24 \pm 5,76$	-9	26	$9,47 \pm 4,73$	$13,9 \pm 9,14$
10.	UI-APog (mm)	$8,14 \pm 1,74$	4,5	11,3	$7,91 \pm 1,57$	$9,27 \pm 2,24$

Table 2. Comparison of Downs cephalometric analysis values between RSGM YARSI, Downs standard values, Deutro-Malay, Negro American, Saudi Arabian, and Mongol Himachali

No.	Variable	RSGM YARSI	Downs	Deutro- Malay	Negro- American	Arab Saudi	Mongol Himachali
1.	Facial angle ($^\circ$)	85,17	87,8*	86,38	85,7	87,7 *	88,35 *
2.	Convexity angle ($^\circ$)	3,62	0 *	8,4 *	9,7 *	4,1	1,92 *
3.	AB plane angle ($^\circ$)	-2,65	-4,6 *	-6,37 *	-6,3 *	-3,9 *	-4,73 *
4.	MP angle ($^\circ$)	29,82	21,9 *	29,19	28,8	24,3 *	23,2 *
5.	Y-axis ($^\circ$)	64,15	59,4 *	63,17	63,4	61 *	59,92 *
6.	Occlusal plane angle ($^\circ$)	11	9,3 *	11,92	10,7	7,1 *	7,3 *
7.	Interincisal angle ($^\circ$)	113,06	135,4 *	119,2 *	119,2 *	124,8 *	130,41 *
8.	LI-occlusal ($^\circ$)	28,41	14,5 *	22,65 *	27,3	23,5 *	19,63 *
9.	IMPA ($^\circ$)	10,24	1,4 *	5,4 *	9,8	6,3 *	3,55 *
10.	UI-APog (mm)	8,14	2,7 *	11,04 *	10,4 *	7,1	5,56 *

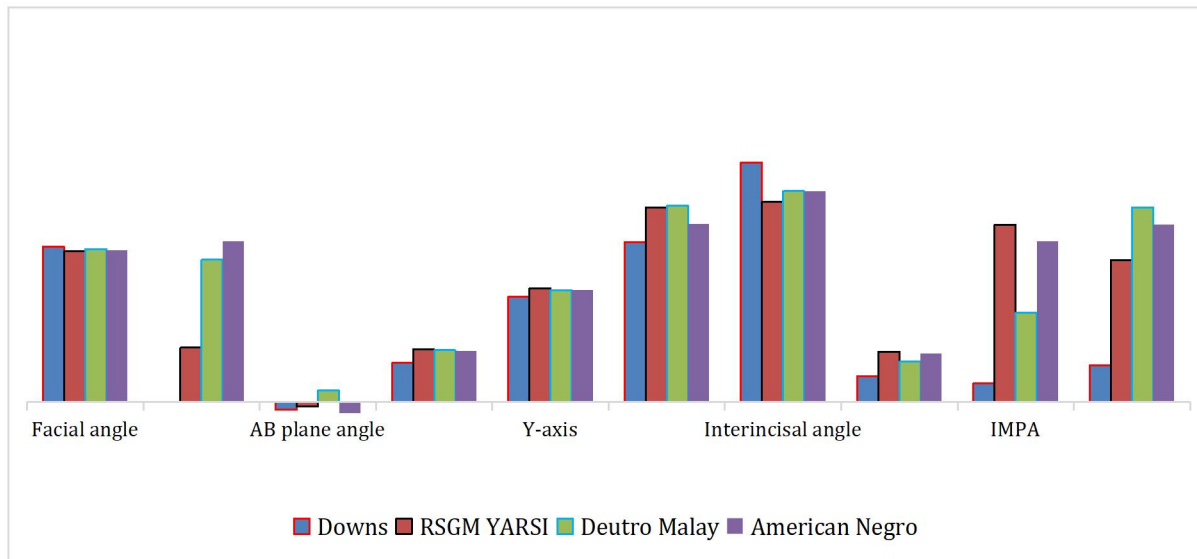


Figure 1. Cephalometric values of Downs analysis at RSGM Yarsi, standard values of Downs, Deutro Malay, and Negro American

Comparison of cephalometric values between the RSGM YARSI and Deutro-Melayu samples (Munandar and Snow, 1995)⁵ shows that the Deutro-Melayu sample has a more convex face (convexity angle, 8.4°) than the RSGM YARSI sample (3.62°). In dental measurements, almost all values between RSGM YARSI and Deutro Melayu show significant differences (Table 2, Graph 1). The mandibular incisors to the mandibular plane (IMPA) in RSGM YARSI subjects were more proclined (10.24°) than Deutro Melayu (5.4°). The maxillary incisors were more retrusive (UI-APog) in RSGM YARSI (8.14 mm) compared to Deutro-Melayu (11.04 mm).

Compared to the RSGM YARSI cephalometric value, the Negro-American sample (Altemus 1960, in Drammond, 1967)⁸ has a more convex face (9.7°) than the RSGM YARSI sample (3.62°). In dental measurements, the distance of the upper incisor to the APog line of RSGM YARSI is smaller (8.14 mm) than that of Negro-Americans (10.4 mm).

Differences also appear between the cephalometric values of the RSGM YARSI and Saudi Arabia (Al-Jasser, 2005)⁶ and Mongolian Himachali (Vaid, 2018)¹¹. Differences with Saudi Arabian cephalometric values appear in all measurements except the convexity angle and UI-APog distance. Differences with Himachali Mongol cephalometric values are apparent in all measurements.

In the skeletal measurements of the RSGM YARSI cephalometric values, there appeared to be a difference between women and men which showed a significantly greater value in the MPA angle for women of 30.37° compared to men of 27.2°. Sexual dysmorphism can also be found in other studies such as research on Koreans by Park (1989) and Manggarai by Ruth (2000).

The results of the comparison between cephalometric values between RSGM YARSI women and Manggarai women (Ruth, 2000)¹² show that there are significant differences for all measurements. Meanwhile, RSGM YARSI men compared to Manggarai ethnic men showed significant differences for all measurements except convexity angle, AB plane angle, and LI-occlusal angle.

The results of a comparison of cephalometric values between RSGM YARSI women and Korean women show that RSGM YARSI women's chins are more repositioned, the profile is straighter, the direction of facial growth is more vertical, and the incisors are more proclined than Korean women. Meanwhile, a comparison of the cephalometric values of

RSGM YARSI men compared to Korean men showed significant differences for all measurements, except the convexity angle (3.6°).

DISCUSSION

The results of measuring the average value of 10 Downs analysis parameters at RSGM YARSI show a significant difference compared to the Downs norm. This may be due to differences in the race of the RSGM YARSI and Downs samples. The RSGM YARSI sample is Indonesian which is Mongoloid sub-race, while the Downs sample is Caucasian race. The direction of mandibular growth of RSGM YARSI subjects showed more vertical growth than the Downs norm. This is in accordance with research by Munandar and Snow (1995)⁵ on the Deutro-Malay ethnic group which stated that Indonesians have a more vertical direction of growth of the mandibular ramus compared to the Downs norm. This indicates that the RSGM YARSI sample is more similar to the Deutro-Malay race than to the Caucasian race.

Indonesia is divided into Mongoloid and Melanesian sub-races. The Mongoloid race can be divided into Deutro-Malay and Proto-Malay races. Ethnicities included in the Deutro-Malay race are Acehnese, Lampung, Javanese, Sundanese, Balinese, Manadonese, Minahasa, Malay, Minangkabau, Betawi, Madurese and Bugis.^{5, 15} The research sample of Munandar and Snow (1995) were 50 Deutro-Malay men and women aged 8-20 years. Comparison of cephalometric values between the RSGM YARSI and Deutro-Malay samples shows significant differences in facial convexity and dental measurements. This may be due to differences in inclusion and exclusion criteria between the RSGM YARSI sample and the Deutro-Malay sample. The inclusion criteria of Deutro-Malay sample in Munandar and Snow (1995) were Deutro-Malay race, had Angle class I molar relationships, and the cephalogram which were pre-orthodontic treatment cases. In this study, the subjects were cephalograms from various ethnicities in Indonesia and the history of orthodontic treatment was not known.

The Negro-American subjects in Altemus' study (in Drammond, 1967)⁸ were taken in North America. There are differences in the cephalometric values of the RSGM YARSI with the Negro-American samples, namely the face is more convex and the lower incisors are more retroclined. These differences are due to racial differences. The RSGM YARSI sample is related to the Mongoloid race, while the Negro-American sample is of the Negroid race. According to Drammond (1967), African Americans have large, strong tongues and soft lips that allow the teeth to be in a protrusive position. The position of the teeth and the thickness of the lips make the lower face look very full.

In skeletal measurements of RSGM YARSI cephalometric values, there appears to be a difference between women and men, namely the direction of growth is more vertical in women, which means female has a more oval face. This is because there is sexual dysmorphism between Indonesian men and women. Sexual dysmorphism can be found in other studies such as research on Koreans by Park (1989)⁹ whose subjects were taken from students at Yonsei University in Seoul, Korea. This research shows that the interincisal angle is smaller in men than in women, which indicates that the incisors of men are more proclined than women, which means the teeth in male are more forward inclined. Between RSGM YARSI women and men compared to Korean women and men showed significant differences in almost all measurements. This may be due to ethnic differences. Koreans belong to East Asia, although both come from the Mongoloid race. Koreans generally have wider faces and relatively narrower noses and lips (Kim et al, 2003).¹⁷ The cephalometric values of Koreans are almost related to those of Chinese and Japanese.¹⁸

Ruth's (2000)¹² research conducted on native Manggarai subject showed differences between men and women that the inclination of the mandibular incisors in men was more labial than those in women. Manggarai Regency is located in West Flores, East Nusa Tenggara,

Indonesia. The Manggarai ethnicity is a mixture of cultural and racial elements between Melanesian and Weddoid. The population of the Weddoid race then mixed with immigrants from the Malay race in western Indonesia.¹⁶ Ruth's (2000) research on the cephalometric value of Downs analysis was carried out on subjects who were native Manggarai residents. The significant differences between RSGM YARSI women and men and Manggarai women and men may be due to the RSGM YARSI sample being more similar to the Deutro-Malay race compared to the Manggarai population which is a mixture of Weddoid, Melanesian and Proto-Melayu races.¹⁶ This indicates that there are differences in cephalometric measurements in different regions in Indonesia.

From the discussion above, it revealed that there are differences between the cephalometric values of Downs analysis at RSGM Yarsi and those of Downs standard values. This could be a consideration using Downs standard values to help orthodontic diagnosis and plan treatment. This study also shows that there are differences in measurements between women and men as well as differences values with other races and ethnicities.

CONCLUSION

There is a significant difference between the values obtained at RSGM YARSI and the Downs standard values in all measurements. Between men and women at RSGM Yarsi there are differences that the female direction of growth are more vertical and male have more proclined anterior teeth. There are differences in measurement values with other races.

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