

Comparison of the head circumference measurement between Down syndrome and normal children

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ABSTRACT

Introduction: Growth and development assessment in children is measured by the head circumference measurement or as known as occipital-frontal circumference. In cases of genetic abnormalities such as Down syndrome which is caused by extra chromosome 21, give distinct features in the craniofacial profile, hence the author finds it is useful to observe the changes in their growth, mainly the head circumference. The purpose of this research is to analyzed comparison between head circumference measurement in children with Down syndrome in Sekolah Luar Biasa-C and normal children, **Methods:** Type of this research is analytical with surveying technique, using cross sectional studies on 20 children with Down syndrome and 160 normal children 6 to 13 years old. The sample subject. Based on anthropometry landmark on point Glabella to Opisthocranium, measurement is taken using a non-stretchable, flexible measuring tape. **Result:** There are significant differences between the head circumference of children in both group according to age and gender; except age 6 male, with the mean value of children with Down syndrome compare to normal circumference measurement were smaller 3 to 5 cm behind the normal children in this research. **Conclusion:** The head circumference of the children with Down syndrome over all from age 6 to 13 years old were smaller than the regular children in same age and same gender.

Key words: Down syndrome, Growth Assessment, Head Circumference Measurement

INTRODUCTION

Down's syndrome is a genetic anomaly in the 21st pair of chromosomes which causes physical and mental impairment, such as muscular hypotonia (in particular oral), congenital heart disease, and reduced immunity, gastrointestinal disorders, obesity, delayed psychomotor development and neurological problems, and hearing and sight deficiencies.¹

Growth occurs in a different way among children with Down's syndrome and it is characterized by earlier onset of the growth spurt

and reduced linear growth velocity, which results in shorter stature than general population.²

Past investigations have indicated that there are delayed developmental of growth occurs among these children diagnosed with Down's syndrome³, Among the most noted delayed developmental can be seen in craniofacial features, including the skull. The skull or head of Down's syndrome is stated to have sloping forehead, flat occipital bone, large fontanelles with late closure, with brachycephaly, microcephaly which is a smaller head circumference from normal growth.⁴ According to research done by Gnanavel Raja C regarding head circumference in children

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of Down's syndrome, it is stated that males had larger circumference than females and growth velocity of the head is that of normal 1 until 5 to 6 months of age. The head circumference data in 0 to 9 months in the present series showed a statistically significant decrease in cases of Trisomy-21. The decrease in the head circumference was carried to the next following age group 9 to 24 months also. This strongly suggests that the head circumferences does not remain static at any given period especially in the very early infancy as stated by Palmer.^{5,6}

Previous studies of Down syndrome showed head circumference measurement give result of smaller measurement (in cm) in comparison to normal growth in various ages. In Suharsini research about cranio-facial measurement in children with Down syndrome in Indonesia using cephalometric x-ray stated that they are significant differences noted in the length of cranium base (nasion-basion) posterior cranium base (sella-basion) compared with normal children, with the children with Down syndrome give smaller measurement. This managed to state that the head circumference of Down syndrome children is affected by the abnormalities of chromosomes 21.⁷

Down's syndrome is among the common classifiable category of mental subnormality, with the incidence at birth is about 1:700 and 1:750 in live birth in most of the countries all around the world, with the risk increases with maternal age.⁸⁻¹⁰ Therefore it is likely that most of dental practitioners will encounter this condition at sometime during their professional lives. Hence it is best for a dentistry student to learn and identify the abnormalities occur in patient with Down syndrome, mainly the head special characteristics as the basic knowledge before giving the treatment in these patient. Based on this matter, I am attracted to do a research about a comparison of head circumference measurement in children with Down's syndrome and regular children ages 6 to 13, using anthropometric landmarks. This research is aimed to compare the head circumference measurement in children with Down syndrome and normal aged 6 to 13 years old.

METHODS

The type of this research is analytical design

with surveying techniques using cross sectional studies to determine the head circumference difference between children with Down's syndrome in SLB-C and normal children in SD Bandung.

The population in this research is children with Down syndrome that are registered as a student in SLB-C Institution in Kota Bandung. Sample from children with Down syndrome are taken using multistage cluster three levels sampling. The first levels are SLB-C institutions in Kota Bandung, The second levels are Wilayah Bandung Utara, and from the third level, 6 SLB-C Institutions were taken and in the third level of sampling, population sample were used as all the sample from selected SLB-C is used in this research as a sample.

The population used for the regular children are normal children in SDN in Kota Bandung. Sample from children with Down syndrome are taken using multistage cluster three levels sampling. The first levels are SDN in Kota Bandung, The second levels are Wilayah Bandung Utara, and from the third level, 2 SDN were taken and in the third level of sampling, simple random sampling were use over a 1, 125 students in SDN Tikukur, and 1, 150 student in SDN Coblong, 160 are taken randomly from each age, 10 boys and 10 girls.

The SLB-C's that were involved includes: SLB-C Asih Manunggal, SLB-C Terate, SLB-C YPLB, SLB Mu-hammadiyah, SLB-C Aditya Grahita, SLB-C YPLAB. The SD that were involved includes: SD Negeri Coblong, SD Negeri Tikukur. The research subject inclusive criteria for children with Down syndrome are children, which have been stated with Down's syndrome abnormalities and were registered as a student in the selected SLB-C Institutions, aged from 6 to 13 before 31st May 2011.

The research subject inclusive criteria for SD children are children aged 6 to 13 before 31st May 2011, present during measurement were taken, and were registered as a student in SDN in Kota Bandung. The exclusive criteria for regular children are stated with genetic or non-genetic abnormalities that can affect the growth of skull or head.

RESULT

The research has been done to compare the head circumference measurement of children

with Down syndrome and regular children. Sample from SLB Institution is 20 children with Down Syndrome from age 6 to 13 years old from each age, while the sample from SD is 160 children from age 6 to 13 years old, whereas 20 children

per age, 10 male and 10 female. Based on the research that was conducted, the result from the data is presented in the following tables and chart as shown below. Figure 1 shows the distribution of the sample based on age and gender. There

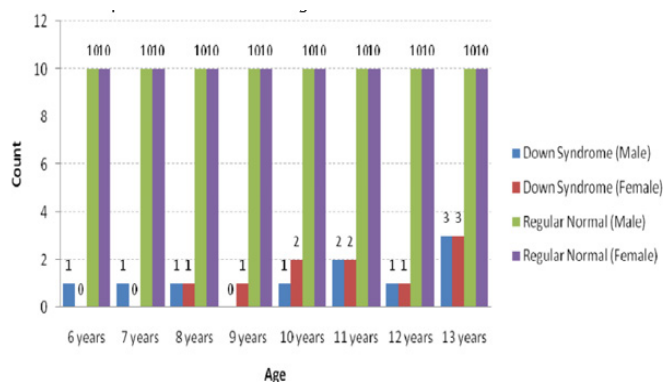


Figure 1. Sample Distribution of children with Down syndrome and Regular Children According to Age and Gender

Table 1. T-test result of head circumference measurement between children with down syndrome and normal children

		Head Circumference			
		Mean	Std. Dev	t	p-value
Age 6 Male	DS	45,57	-	-2,097	0,158
	Normal	49,56	1,858		
Age 7 Male	DS	45,63	-	-2,408	0,039
	Normal	50,05	1,751		
Age 8 Male	DS	46,53	-	-2,93	0,017
	Normal	50,98	1,449		
Age 10 Male	DS	48,00	-	-4,931	0,001
	Normal	51,87	0,748		
Age 11 Male	DS	48,73	1,556	-2,446	0,035
	Normal	52,54	2,053		
Age 12 Male	DS	50,13	-	-2,362	0,042
	Normal	52,05	0,775		
Age 13 Male	DS	49,85	2,062	-3,945	0,002
	Normal	52,57	0,625		
Age 8 Female	DS	46,43	-	-5,377	0,000
	Normal	51,28	0,860		
Age 9 Female	DS	48,10	-	-3,148	0,012
	Normal	51,57	1,051		
Age 10 Female	DS	47,25	3,932	-3,238	0,009
	Normal	51,97	1,491		
Age 11 Female	DS	46,17	2,454	-3,547	0,005
	Normal	52,15	2,146		
Age 12 Female	DS	48,07	-	-3,185	0,011
	Normal	52,78	1,410		
Age 13 Female	DS	48,33	0,558	-6,049	0,000
	Normal	53,73	1,475		

were no samples for female children with Down syndrome for age 6 and 7, and male children with Down syndrome for age 9. As for the sample for regular children were 10 male and 10 female per age.

Table 1 shows the result of t-test for head circumference measurement in age 6-13 male and female between children with Down syndrome and normal children. From the table above, head circumference of male shows no significant differences between children with Down syndrome

and normal children in age 7 ($0,039 < 0,05$), 8 ($0,017 < 0,05$), 10 ($0,001 < 0,05$), 11 ($0,035 < 0,05$), 12 ($0,042 < 0,05$), and 13 ($0,002 < 0,05$). For age 9 male, the comparison of head circumference can't be done because the sample of children with Down syndrome were none, thus it is invalid for t-test rule of sample must be at least 1. As for comparison of age 6 and 7 female, the comparison of head circumference can't be done because the sample of children with Down syndrome were none, thus it is invalid for t-test as for the rule for

Table 2. Mean Value of Head Circumference Measurement for Male According to Age

Age	6 years	7 years	8 years	9 years	10 years	11 years	12 years	13 years
Male								
Down Head Syndrome	45.57	45.63	46.53	0.00	48.00	48.73	50.13	49.85
Normal Circumference Regular	49.27	50.05	50.98	51.84	51.87	52.54	52.05	52.57
Female								
Down Head Syndrome	0.00	0.00	46.43	48.10	47.25	46.17	48.07	48.33
Normal Circumference	49.85	51.02	51.28	51.57	51.97	52.15	52.78	53.73

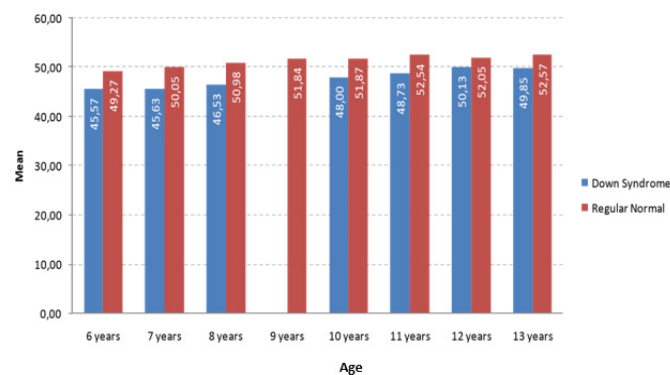


Figure 2. Mean Value of Head Circumference Measurement of Children with Down syndrome and Regular Children in Male According to Age

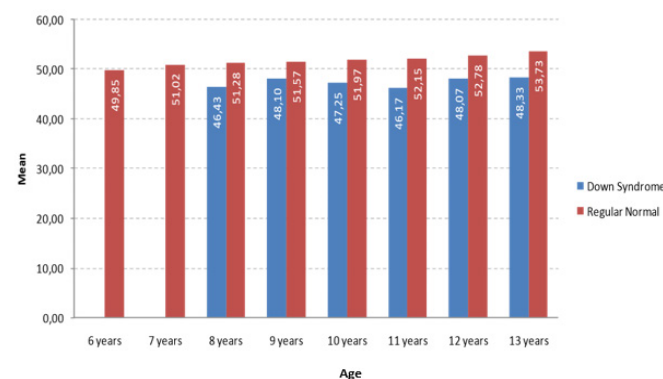


Figure 3. Mean Value of Head Circumference Measurement of Children with Down syndrome and Regular Children in Female According to Age

sample must be at least 1. Also from table 1, there is significant difference between female children with Down syndrome and normal in age 8 ($0,000 < 0,05$), 9 ($0,012 < 0,05$), 10 ($0,009 < 0,05$), 11 ($0,005 < 0,05$), 12 ($0,011 < 0,05$), and 13 ($0,000 < 0,05$).

Table 2 shows the mean values of head circumference measurement for children with Down syndrome and children and normal for male and female, according to age. The mean value shows 0.00 at male age 9 and female age 6 and 7 because there were no samples of children with Down syndrome from this age. Regular children give higher mean value compare to children with Down syndrome in every age.

Figure 2 shows the mean value of male head circumference measurement versus age between children with Down syndrome and normal children. In age 8 shows the biggest value in comparison of both groups with the value of 4.45. In age 9, there were no sample for children with Down syndrome; therefore the value 0.00 is noted in graph. Over all, the mean value of head circumference measurement from children with Down syndrome and normal children in every age shows different value, with the regular children presented higher mean value than the former.

Figure 3 shows the mean value of female head circumference measurement versus age between children with Down syndrome and regular children. In age 11 shows the biggest value in comparison of both groups with the value of 5.98. In age 6 and 7, there were no sample for children with Down syndrome; therefore the value 0.00 is noted in graph. Over all, the mean value of head circumference measurement from children with Down syndrome and normal children in every age shows different value, with the normal children presented higher mean value than the former.

DISCUSSION

Based on the research, the overall head circumference measurement of children with Down syndrome gives a smaller mean value when compared to normal children in every age in both male and female, with around 3 to 5 cm behind the regular children head circumference. This result is quite close with research done by Handol (1998) about head circumference of children with Down syndrome which stated the head expands

slowly, about 4 to 5 cm behind the normal children for the age after 9 months old. Such result can appear probably because of the developmental delay noted among children with Down syndrome as stated by Len Lenshin (1997) in his article.^{3,11}

The result of this research is also similar to previous studies of anthropometric measurement done by Ivana Bagic and Zeljko Verzak in 2003, which stated that head circumference measurement of children with Down syndrome is smaller due to their genetic abnormalities of chromosomes 21. The characteristic of flat occipital bone that can be noted on the Down syndrome patient contributes to the small reading in the measurement. This reading can also caused by the mental retardation in children with Down syndrome, thus affecting the brain volume to decrease which resulted in the head circumference reading is smaller than normal.¹²

As stated in Gardiner K (2000) in his studies about mainly chromosome 21, anomalies in this particular chromosome may disrupt the course of normal development of the body, with intellectual disability, delayed development and characteristics facial features, as this disturbances can be seen in Down syndrome patient.¹³ The intellectual disability that were noted in Down syndrome, are shown in their IQ test result ranging from 20 to 65 with mean value of approximately 50 from previous research implying that this children have moderate to severe mental retardation which inhibits the brain growth, thus directly affecting head circumference measurement.¹⁴

Looking through the result from male sample for normal children, the number of mean value increasing as the age also increased, as the female result of head circumference measurement from regular children, also gives increasing number as the age increased. The result proved the research done by Palmer 2002 which stated that head circumference never remain static given any period of years until human reaches adolescence which the human at the stage of life reaches its final growth and development.⁶

The result of head circumference measurement in children with Down syndrome in comparison to regular children were proven statistically significant in both female and male according to age, except in age 6 male where the difference were noted but were statistically

insignificant. This result is probably because of the subjects from children with Down syndrome assume to be from Down syndrome with the least shown characteristics which is the Mosaics type. Mosaics Down syndrome is defined as the error or misdivision that occurs after fertilization at some point during early cell division mainly in mitosis stage. This type accounts for about 2 to 4% of all cases of Down syndrome.¹⁵

It is said that individuals with this type may or may not have milder disabilities and less obvious features of Down syndrome. Because the levels of mosaicism vary between individuals and within the cells of the individuals themselves, the effect of mosaicism is wide and variable. Studies also shown that individuals with Mosaic Down syndrome can have all of the problem or characteristics associated with full trisomy 21, none of the problems, or somewhere in between.¹⁶ There are one report published in 1991 by Fishler K regarding mental development in the Down syndrome mosaicism, comparing 30 children with mosaic Down syndrome with 30 children with typical Down syndrome.¹⁷

IQ testing showed that the mean IQ of the mosaic group was 12 points higher than the mean of the non-mosaic group. As the theory earlier by Tan 1969, the brain that changed either in measurement or development before the individual reaches it puberty, that changes will determined the size and shape of the head.¹⁸ Therefore IQ test can be used as one of the parameter to indicate brain growth, as lower IQ test marks might indicates minimum level of brain growth, thus affecting the head in its width, in other word, smaller head circumference. Further research should be done regarding this matter to support this theory about types of Down syndrome and how it affects their IQ and brain growth.

The number was statistically insignificant for age 6 male in comparison for both sample group, were probably because of the small mean value of head circumference of regular children. Smaller head circumference, could be cause by many factor, including environmental such as under nutrition which can be assume affected the measurement. As stated by Skull SA on his previous study, malnutrition in a longer period of time can contribute to microcephaly with lower overall body mass. It could be assume that

the regular children might be under malnutrition thus affecting the measurement when its taken in this research.¹⁹ Further research can be done regarding this matter to support this theory in the same sample size if possible.

Treatment of smaller head circumference of if it is under 2 SD measurement of normal head circumference, it can be categorized as microcephaly, can be treated if latter is not present with genetic abnormalities. A thorough family history should be taken, seeking additional cases of microcephaly or disorders affecting the nervous system. It is important to obtain the patient's head circumference at birth. Once the cause of the microcephaly has been established, the physician must provide accurate and supportive genetic counseling, but because microcephaly can be associated with genetic abnormalities and mental retarded, the physician must assist with placement in an appropriate program that will provide maximum development of the child.

The limitation of the study were limited sample for children with Down syndrome as they are difficult to locate, as many of them may not registered to a school, or absent during the head circumference measurement were taken. The author somehow managed to take data and measurement in the month of May using maximum sample that were available in the duration of the research.

CONCLUSION

The head circumference of the children with Down syndrome over all from age 6 to 13 years old were smaller than the regular children in same age and same gender.

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