Original Article

IAHS Medical Journal
Volume 07 Issue 02 December 2024; 9-13

Comparison of Craniofacial Dimensions between Thalassemic Patients and Non-thalassemic Healthy Individuals: A Morphometric Study

Sabrina Tasnim[1*] Md. Ashrafuzzaman[2] Urmila Chowdhury[3] Baishakhi Bhowmick[1]
Jehan Hashem[4] Abdul Quader Mohammad Mohiuddin Masum[5] Shehrin Islam[6]

ABSTRACT

Background: *Expansion of the bone marrow and secondary skeletal and craniofacial deformity are mainly seen in poorly treated thalassemic patients. Craniofacial anthropometry is a useful method that assists clinicians to identify deformities. The purpose of this study was to assess the craniofacial characteristics in transfusion dependent thalassemic patient in Bangladesh.*

Materials and methods: *This cross-sectional analytical study was conducted during the period from October 2021 to September 2022 in the Department of Anatomy, Chittagong Medical College, Chattogram, upon 100 respondents (50 transfusion dependent thalassemia patients and 50 non-thalassemic healthy individuals) of 5-30 years. Digital slide caliper and tape were used to measure 10 anthropometric parameters (6 horizontal, 3 vertical, and 1 head circumference) in cranial, facial, nasal and orbital zones. For statistical analysis Mann-Whitney U test was done and p-value was considered significant if it was <0.05 at 95% level of confidence.*

Results: *This study showed a significant difference (p = 0.012) between mean values of intercanthal width in transfusion dependent thalassemia patients and non-thalassemic healthy individuals. The difference between the head circumference, facial and nasal zone parameters of transfusion dependent thalassemia patients and non-thalassemic healthy individuals was not found to be statistically significant (p > 0.05).*

Conclusion: *The baseline data from the study will help us better understand the craniofacial structure of thalassemic patients who rely on transfusions and will also allow us to get satisfactory results in diagnosing and treating their craniofacial illness.*

Key words: Craniofacial measurements; Morphometric study; Thalassemia; Transfusion dependent

Introduction

Thalassemia is a diverse group of genetic diseases characterized by absent or deficient synthesis of one or more of the alpha or beta globin chain subunits of hemoglobin.[1,2] Worldwide, HbE β-thalassemia may be the most important hemoglobinopathy because of the high gene frequencies for both HbE and β-thalassemia. In Southeast Asia including the Indian subcontinent, it is the most common form of severe thalassemia due to the coinheritance of HbE and beta trait.[3] Three groups for HbE beta thalassemia could be made based on clinical severity: mild, moderate, and severe.[4] In each year, over 50,000 new patients are born with a severe form of thalassemia (beta-thalassemia major and HbE beta thalassemia) worldwide. There is up to 60% prevalence of the carrier state in South East Asian nations.[3] The most prevalent type of thalassemia in many Asian nations is caused by the co-heritance of HbE and beta thalassemia. The most common hemoglobin variety is HbE, which is found in Bangladesh, various Southeast Asian nations, and the eastern regions of the Indian subcontinent.[5] Patients with thalassaemia major, severe Hb E/ thalassaemia, transfusion dependent Hb H disease and some other type of thalassemia require regular blood transfusion, typically given every 3 to 4 weeks to survive.[6]

The documented orofacial manifestations of beta-thalassemia are prominent cheek bones with a protrusive maxilla due to erythroid hyperplasia with the

1. Lecturer of Anatomy
Chittagong Medical College, Chattogram.
2. Professor of Anatomy
Chittagong Medical College, Chattogram.
3. Assistant Professor of Anatomy
Chittagong Medical College, Chattogram.
4. Assistant Professor of Anatomy
Marine City Medical College, Chattogram.
5. Lecturer of Oral Microbiology
Chittagong Medical College, Chattogram.
6. Assistant Professor of Anatomy
City Medical College, Gazipur, Dhaka.

*Correspondence : **Dr. Sabrina Tasnim**
Cell : +88 01629 86 35 45
Email : manillatasnim122@gmail.com

Date of Submission : 2nd November 2024
Date of Acceptance : 16th November 2024

IAHS Medical Journal
Volume 07 Issue 02 December 2024; 9-13

depression of the bridge of the nose.[7] The maxillary anterior teeth show indications of projection, flare, and spacing in the dentition.[8] These orofacial changes of thalassemic patient are due to bone changes associated with ineffective erythropoiesis. As the bones deteriorate, pathological fractures could happen. The usual facial appearance is caused by the excessive expansion of the bone marrow, which has been linked to changes in the cranial and facial bones. The deformations of the "Squirrel-like" face are attributed to multi-directional growth, covering the maxillary region in particular. Features characterized by prominent frontal and parietal bones, a collapsed nasal bridge and upward-slanted eyes are defined as a slightly mongoloid facial deformity in some patients.[9-11]

Craniofacial anthropometry is a useful numerical identification method that assists clinicians to identify deformities and helps surgeons at the stage of reconstructive intervention.[12] Some medical conditions such as thalassemia are often associated with varying degrees of craniofacial anomalies.[13]

Despite the fact that Bangladesh lies in the world's thalassemia belt, the information on different aspects (Epidemiology, clinical course, mortality, complications and treatment outcomes) of thalassemia is lacking.[14] World Health Organization (WHO) reported in 2008 that, 3% of total Bangladeshi population is carriers of beta thalassemia and 4% are carriers of HbE beta thalassemia in Bangladesh.[15] At present, no comprehensive craniofacial study regarding Thalassemia from Bangladesh has been carried out. Present study aimed to evaluate anthropometrically the craniofacial dimensions of transfusion dependent thalassemia patients.

Materials and methods

This cross sectional analytical study was carried out in the department of Anatomy of Chittagong Medical College, Chattogram during the period from October 2021 to September 2022 among conveniently selected 100 respondents (50 transfusion dependent thalassemia patients and 50 non-thalassemic healthy individuals) of 5-30 years. Data were collected from three centers of Chattogram- the Department of Pediatrics, Department of Hematology of Chittagong Medical College Hospital and and Fatema Begum Red Crescent Blood Center, Chattogram. Approval was taken from Ethical Review Board of Chittagong Medical College.

The subjects were grouped as transfusion dependent thalassemia patients and non-thalassemic healthy individuals according to the result of Hb Electrophoresis. The non-thalassemic healthy individuals were age matched with the transfusion dependent thalassemia patients. The study subjects were from mainstream population who had no history of congenital craniofacial abnormality, major craniofacial trauma, orthodontic treatment or craniofacial reconstructive surgery. Participants were informed of the study steps and ensured of the safety study procedure. Then, all measurements were taken directly on the labeled faces of the subjects while applying minimal pressure to the soft tissues, according to Farkas method by using measuring tape and digital slide caliper.[16] Validated methods were followed to measure head circumference, head width, face width, face heigh, nose width, nose height, nose tip protrusion, biorbital width, intercanthal width and nose root width.[17,18,12,19].

A great care was made to use, read and to record the reading from the morphometric tools, as accurately as possible. All measurements were recorded for three times and average was calculated to obtain a single representative value. Every individual took about the same amount of time-roughly 30 minutes on average-to complete the craniofacial measurements.

All data were fed into Statistical Package for Social Sciences (SPSS-26) software for processing and analysis. Data were presented as number, percentage, or mean ± standard deviation. For comparison, the unpaired Student's t-test and Mann-Whitney U test were used as appropriate. Results were considered as significant if p value was <0.05 at 95% level of significance.

Results

Out of 100 participants, there were 62 (62.0%) males and 38 (38.0%) females. The age of the respondents ranged from 5-30 years with the mean ± SD age of 14.86±7.10 years. The mean head circumference, nose height, nasal root width, and nasal tip protrusion of thalassemic patients were greater than those of non-thalassemic individuals, though these differences were not statistically significant ($p>0.05$). There was a statistically significant difference in the intercanthal width between thalassemic patients and non-thalassemic individuals ($p = 0.012$), indicating that thalassemic patients tend to have a wider intercanthal distance. Although non-thalassemic individuals were likely to have a wider head, face, nose, and interorbital space as well as a longer face, these differences were not statistically significant (Table I).

IAHS Medical Journal
Volume 07 Issue 02 December 2024; 9-13

Table I Craniofacial Dimensions

Region	Measurements	Thalassemic (n=50)	Non-thalassemic (n=50)	p value
Head	Head circumference (cm)	52.19±1.96	52.09±2.57	p=0.831
	Head width (cm)	14.47±0.94	14.77±1.54	p=0.823
Face	Face width (cm)	11.93±1.01	12.05±1.49	p=0.644
	Face height (cm)	10.21±0.92	10.59±1.42	p=0.117
Nose	Nose width (mm)	31.80±4.93	32.35±4.13	p=0.831
	Nose height (mm)	39.53±4.94	37.89±6.22	p=0.197
	Nasal root width (mm)	22.12±5.04	20.31±6.01	p=0.106
	Nasal tip protrusion (mm)	21.10±5.28	19.14±7.21	p=0.124
Eye	Biorbital width (mm)	98.06±6.94	99.65±7.80	p=0.284
	Intercanthal width (mm)	31.34±4.93	29.10±3.99	*p=0.012

* p<0.05= significant.

Discussion

During this study, measurements were taken from four craniofacial regions of the transfusion dependent thalassemia patient group and the non-thalassemic healthy group. Upon reviewing the literature, only a few researches were discovered that particularly examined the anthropometric measurements of the face and jaw in thalassemia patients by direct approach. In some studies measurement methods were different from this piece of work.[10,20,21]

In the present study, the mean of the head circumference in thalassemia patient group was 52.19±1.96 cm and in non-thalassemic group it was 52.09±2.57 cm. This was statistically not significant (p=0.831). In a comparative study between 43 thalassemia major patients and 26 normal people in Turkey revealed that head circumference in thalassemia patient group was (53.1±2.8) cm and in control subjects (54.4±2.4) cm. However, the values were not statistically significant (p=0.051). The findings of this study are analogous to the present study.[13] A study in Iran conducted between30 thalassemia patients (14 females and 16 males) and 30 normal people (15 females and 15 males), head circumference showed different values among thalassemia patient group: 56.023±2.73 cm and control group: 56.25±3.45 cm and it was statistically significant (p<0.01). The findings of this study are dissimilar with the present study and this dissimilarity may be due to ethnic or sample size variation.[22]

In present study, the mean head width of the thalassemia patient group was 14.47±0.94 cm, compared to 14.77±1.54 cm in the non-thalassemic group, with no statistically significant difference observed (p=0.823). Turkish study revealed that head width in thalassemia patient group was 14.8±0.7 cm and in control subjects (14.7±0.8) cm. However, the values were not statistically significant (p=0.150). The findings of this study are alike the present study.[13] Among the Iranian population head width in thalassemia patient group 15.525±4.65 cm and in control group was 15.441±2.92 cm and it was statistically not significant (p<0.4). The findings of this study are dissimilar with the present study and this dissimilarity may be due to ethnic and racial variations and different sample size.[22]

In present study, the mean face width in thalassemia patient group and in the non-thalassemic group was 11.93±1.01 cm and 12.05±1.49 cm respectively. The difference was statistically not significant (p=0.644). Turkish study discovered that mean face width in thalassemia patient group and in the non-thalassemic group was 10.60 cm and 10.49 cm respectively, with no statistically significant difference observed (p=0.213).[13] This coincides with the present study. The finding of the Iranian study is dissimilar with the present study where the mean face width in thalassemia patient group and in the non-thalassemic group was 14.811±6.43 cm and 13.635±4.85 cm respectively.[22]

In this study, the mean face height was 10.21 ± 0.92 cm in the thalassemia patient group and 10.59 ± 1.42 cm in the counter group, with no statistically significant difference (p = 0.117). Turkish study revealed that face width in thalassemia patient group was 10.39 cm and in control subjects 11.91 cm. However, the values were statistically significant (p value =0.014).[13] The values and trend of this study are comparable to the present study. However, the values were much higher among Iranian people, with the thalassemia patient group having a wider head (14.811 ± 6.43 cm) compared to the control group (13.635 ± 4.85 cm)(22). The current study's findings differ from this one's, which could be explained by differences in sample size and ethnicity.

In this study, the non-thalassemic group (32.35±4.13 mm) had a wider nose compared to the thalassemia patient group (31.80±4.93 mm) but it was statistically not significant (p value =0.831). In Iran the non-thalassemic group (34.75±2.35 mm) had a wider nose compared to the thalassemia patient group (33.85±2.35 mm).[22] The values and trend of this study are comparable to the present study. But in Turkey the thalassemia patient group having a wider nose (26.15±3.9 mm) compared to the control group (24.14±3.3 mm).[13]

In the current study, the thalassemia patient group had a longer nose (39.53±4.94 mm) compared to the non-thalassemic group (37.89±6.22 mm) with no statistically significant difference (p=0.197) wider nasal root (22.12±5.04 mm) compared to the non-thalassemic group (20.31±6.01 mm) with no statistically significant difference (p= 0.106). Data from

IAHS Medical Journal
Volume 07 Issue 02 December 2024; 9-13

Turkey revealed that the non-thalassemic group (63.5 mm) had a longer nose compared to the thalassemia patient group (52.3 mm) and it was statistically significant ($p<0.05$), narrower nasal root (19.9±1.9 mm) compared to the thalassemia patient group (20.91±2.32 mm) and it was statistically significant ($p=0.007$).[13] In the current study, thalassemia patients (21.10±5.28 mm) had a longer nasal tip protrusion compared to the non-thalassemic group (19.14±7.21 mm) with no statistically significant difference ($p = 0.124$). Feature was reverse in Turkish people, non-thalassemic group (21.55 mm) had a longer nasal tip protrusion compared to the thalassemia patients (18.7 mm) with statistical significance ($p = 0.124$).[13] The observed differences may be the combined effect of methodological, environmental, genetic and cultural factors.

In this study, the non-thalassemic group (99.65±7.80 mm) had a greater biorbital width compared to the thalassemia patient group (98.06±6.94 mm) with no statistically significant difference (p value =0.284), the thalassemia patient group had a greater intercanthal width (31.34±4.93 mm) compared to the non-thalassemic group (29.10±3.99 mm) with statistically significant difference ($p=0.012$).[13] Values regarding biorbital width of Turkish people are lesser than those of present study but the trend is analogous with the findings of present study. But in Iran, the thalassemia patient group had a greater biorbital width compared to the non-thalassemic group (97.29±2.65 mm vs. 93.5±2.75 mm) and this difference was statistically significant ($p<0.001$).[22] In Turkey the thalassemia patient group had a greater intercanthal width compared to the non-thalassemic group (30.85±3.19 mm vs. 30.51±3.35 mm), but this difference was not statistically significant ($p=0.683$).[13] But in Iran, the non-thalassemic group had a greater biorbital width compared to the thalassemia patient group (32.5±2.8 mm vs. 31.98±2.375 mm) and this difference was not statistically significant ($p>0.05$).[22] The observed differences may be the combined effect of methodological, environmental, genetic and cultural factors.

Limitations

The study was restricted to a selected area with relatively small sample size with no sex-matching. Fewer anthropometric parameters were included in this study. So the data from the present study may not be comprehensive and generalized for Bangladeshi population.

Conclusion

The study offers insightful information about the differences in craniums between those who are thalassemic and those who are not. The results showed that, while not statistically significant, thalassemic patients tended to have larger head circumference, nose height, nasal root width and nasal tip protrusion than non-thalassemic people. The intercanthal width did, however, show a statistically significant difference, indicating that thalassemic patients generally have a wider intercanthal distance. The findings highlighted the necessity for additional investigation into the effects of age, gender, and other possible confounding variables. These results may also be useful to physicians in the early detection and screening of the illness, which would enable prompt treatment and intervention. Treatment regimens for thalassemic patients that are customized in orthodontics and surgery can meet their specific requirements, enhancing results and minimizing side effects. This will add a substantial amount of data to the corpus of current knowledge.

Recommendation

Larger sample size from multistage sampling is required for more robust finding of such study. Tribal population can be included in further studies to observe any significant difference between tribal and normal Bengali population.

Acknowledgement

I express my sincere gratitude to Professor and Head of the Department of Hematology, Professor and Head of the Department of Pediatrics, Chittagong Medical College Hospital and In-charge of Fatema Begum Red Crescent Blood Center, Chattogram for their inspiration and valuable suggestions.

Disclosure

All the authors declared no competing interests.

References

1. Weatherall DJ, Clegg JB. The Thalassaemia Syndromes [Internet]. 4th ed. Wiley. 2001;1-16. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470696705.

2. Hazza'a AM, Darwazeh AMG, Museedi OSM. Oral Candida flora in a group of Jordanian patients with -thalassemia major. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology. 2010;109(2):252–256.

IAHS Medical Journal
Volume 07 Issue 02 December 2024; 9-13

3. Vichinsky EP. Changing Patterns of Thalassemia Worldwide. Annals of the New York Academy of Sciences. 2005;1054(1):18–24.

4. Viprakasit V, Ekwattanakit S. Clinical Classification, Screening and Diagnosis for Thalassemia. Hematology/Oncology Clinics of North America. 2018;32(2):193–211.

5. Olivieri NF. The β-Thalassemias. N Engl J Med. 1999;341(2):99–109.

6. Cappellini MD. THALASSAEMIA INTERNATIONAL FEDERATION. https://www.thalassemia.org/wp-content/uploads/2021/06/TIF-2021-Guidelines-for-Mgmt-of-TDT.pdf.

7. Kaplan RI, Werther R, Castano FA. Dental and Oral Findings in Cooley's Anemia: A Study of Fifty Cases. Annals of the New York Academy of Sciences. 1964;119(2):664–666.

8. Cannell H. The development of oral and facial signs in beta-thalassaemia major. Br Dent J. 1988 Jan;164(2):50–51.

9. Ba simitçi , Yücel-Ero lu E, Akalar M. Effects of Thalassaemia Major on Components of the Craniofacial Complex. British Journal of Orthodontics. 1996;23(2):157–162.

10. Alhaija ESJA. Cephalometric measurements and facial deformities in subjects with -thalassaemia major. The European Journal of Orthodontics. 2002;24(1):9–19.

11. Toman HA, Nasir A, Hassan R, Hassan R. Skeletal, dentoalveolar, and soft tissue cephalometric measurements of Malay transfusion-dependent thalassaemia patients. The European Journal of Orthodontics. 2011;33(6):700–704.

12. Kolar J, Salter E. Craniofacial anthropometry: Practical measurement of the head and face for clinical, surgical and research use. 1st ed. Springfield, Illinois: Charles C Thomas Publisher Ltd. 1997.

13. Karakas S, Metin Tellioglu A, Bilgin M, Kurt Omurlu I, Caliskan S, Coskun S. Craniofacial Characteristics of Thalassemia Major Patients. Eurasian J Med. 2017;48(3):204–208.

14. Rahman S, Ahmed T, Rahman AS, Alam N, Ahmed AS, Ireen S, et al. Determinants of iron status and Hb in the Bangladesh population: the role of groundwater iron. Public Health Nutr. 2016;19(10):1862–1874.

15. Khan W. Prevention is the only way to combat Thalassemia. The Daily Star. Web Edition 5. 2006;1.

16. Farkas LG. Anthropometry of the head and face. 2nd ed. New York: Raven Press. 1994.

17. U.S. Department of Health and Human services. Measuring Head Circumference [Internet]. Centers for Disease Control and Prevention. 2016. https://www.elpasotexas.gov/assets/Documents/CoEP/Public-Health/Current-Events/Zika-Virus-Page/microcephaly_measuring.pdf.

18. Jervas E, Anibeze C. Stature Estimation of the Igbos Using Cephalo-Facial Anthropometry. J Forensic Res. 2015;06(04):1000295.

19. Suhk J, Park J, Nguyen A. Nasal Analysis and Anatomy: Anthropometric Proportional Assessment in Asians—Aesthetic Balance from Forehead to Chin, Part I. Seminars in Plastic Surgery. 2015;29(04):219–225.

20. Takriti M, Dashash M. Craniofacial parameters of Syrian children with β-thalassemia major. J of Invest & Clin Dent. 2011;2(2):135–143.

21. Roussos P, Mitsea A, Halazonetis D, Sifakakis I. Craniofacial shape in patients with beta thalassaemia: a geometric morphometric analysis. Sci Rep. 2021;11(1):1686.

22. Naeimi AJ. Investigating the relationship between major thalassemia diseases with anthropometric sizes of head and facial soft tissue. Bioscience Biotechnology Research Communications. 2017;10:233–240.