

Comparative Anthropometric Study about Growth in Head and Skeleton between Children with Autism Spectrum Disorder and Normal Children of Bangladesh

Md. Ibrahim Sohel^{1*} Md. Ashrafuzzaman² Asma mostafa³ Mohammad Monir Hossain⁴ Md. Anwarul Kibria⁵

ABSTRACT

Background: A child grows in various ways like physical, mental, emotional, social and cultural growth. Physical, mental and social developments are influenced by nutrition. Body composition is strongly associated with nutritional status, specific diet, physical exercise, diseases and genes. The determination of body composition allows for the quantitative assessment of muscle mass and adiposity changes that reflects nutritional intake, losses and expenses over a time period. Thus, the present study was carried out to measure the head circumference, mid arm circumference, waist circumference and mid-thigh circumference of children with autism spectrum disorder and to evaluate if there is any significant difference with normal children of Bangladesh. The outcome of the study would be helpful for further research work to establish brain growth, assessment of growth and comparison between children with autism spectrum disorder and normal Children in Bangladesh.

Materials and methods: It was cross-sectional and observational study. The study population was Group A consists of 100 normal Bangladeshi children and Group B consists of 100 Bangladeshi children with Autism spectrum disorder, aged between 02 and 18 years collected by convenient sampling. Four variables namely head circumference, mid arm circumference, waist circumference and mid-thigh circumference were analyzed in this study.

Results: Children with autism spectrum disorder had statistically significant lower head and mid thigh circumference; mid arm and waist circumference had statistically non-significant.

Conclusion: The results of this study provide the baseline information about assessment of brain growth and nutritional growth of muscles mass of normal children and children with autism spectrum disorder in Bangladesh which will help to monitor brain & nutritional growth of children.

Key words: Autism Spectrum Disorder (ASD); Head circumference; Mid arm circumference; Mid thigh Circumference; Waist circumference.

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopment disability characterized by deficits of social and emotional reciprocity and by repetitive, restricted and stereo typed patterns of behaviour and interests¹. Although it can be diagnosed at any age, but it said to be “development disorder” because generally appear in the

first two years of life². According to the National Institute of Mental Health, autism spectrum disorder is a developmental disorder that affects both communication and behavior of the affected individual³. It is highly inheritable and is diagnosed in more than 1% of children worldwide⁴. Autism spectrum disorder occurs in all ethnic, racial and economic groups. Children with autism spectrum disorder have varying of difficulties in social interaction, language and communication as well as normal behavior⁵. All of the earlier genetic studies have suggested that autism is heterogeneous⁶. Research into this disorder is increasingly focused on both genetic causes and neuroanatomical bases for the heterogeneous behavioral and clinical phenotypes⁷.

The autism spectrum disorder prevalence rate in Bangladesh is increasing gradually. A national level study in Bangladesh during 2013 used community health worker, has found prevalence of ASD; the study indicates a prevalence of 1.5/1000 (30/1000 in Dhaka city and 7/10,000 in rural area) within 7200 population. In 2016, Institute of Paediatric Neurodisorder and Autism (IP-NA) rural survey reported a figure of 7.5 per 10,000 children aged between 18 and 36 months⁸. The Daily Star published a report in 2018 mentioning that, according to a survey conducted by Dhaka Shishu Hospital in 2013, autism prevalence to be 15 per 10,000 children aged below nine⁹.

1. Assistant Professor of Anatomy, Chattogram Maa-O-Shishu Hospital Medical College, Chattogram.
2. Professor of Anatomy Chittagong Medical College, Chattogram.
3. Professor of Anatomy Chattogram Maa-O-Shishu Hospital Medical College, Chattogram.
4. Assistant Professor of Anatomy Eastern Medical College, Cumilla.
5. Assistant Professor of Neurology Chittagong Medical College, Chattogram.

*Correspondence : **Dr. Md. Ibrahim Sohel**
Cell : +88 01675 08 53 44
Email : ibrahimsohel45@gmail.com

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A child grows in various ways like physical, mental, emotional, social and cultural growth¹⁰. Physical, mental and social developments are influenced by nutrition. Body composition is strongly associated with nutritional status, specific diet, physical exercise, diseases and genes. The determination of body composition allows for the quantitative assessment of muscle mass and adiposity changes that reflects nutritional intake, losses and expenses over a time period¹¹. The direct effect of under nutrition is related to retarded physical and mental growth. The indirect effects are high among young and growing children and leads to retarded physical and mental growth, lowered vitality leading to lowered productivity and reduced life expectancy, poor concentration and abnormal behaviour^{2,12}.

During childhood the nutrient requirements of the body are high and as such the nutritional status of children needs to be monitored closely by certain anthropometric methods like mid upper arm circumference, waist circumference and mid-thigh circumference. Children with under nutrition are not only at risk of morbidity and mortality but also likely to perform poorly in their academic activities¹³. Head circumference is an important marker of brain growth, development, intelligence and outcome. Children with Autism spectrum disorder have significantly poor brain development resulting microcephaly. Head circumference is one physical finding in autism that varies significantly from normal children¹⁴. Thus, the present study was carried out to measure the head circumference, mid arm circumference, waist circumference and mid-thigh circumference of children with autism spectrum disorder and to evaluate if there is any significant difference with normal children of Bangladesh. The outcome of the study would be helpful for further research work to establish comparison between children with autism spectrum disorder and normal Children in Bangladesh.

Materials and methods

It was cross-sectional and observational study with some analytical components, carried out in the Department of Anatomy, Chittagong Medical College, Chattogram, during the study period of July, 2018 to June, 2019. The study population was divided into two groups. Group A was 100 normal Bangladeshi children and Group B was 100 Bangladeshi children with autism spectrum disorder aged between 02 and 18 years collected by convenient sampling. Those having any skeletal disease/deformity, mixed in origin, Rickets or kidney diseases, craniofacial reconstructive surgery and tribal people were excluded from the study. Ethical clearance for doing the research was obtained from the Institutional Review Board /Ethical Review Board (E.R.B) of Chittagong Medical College.

Four variables namely head circumference, mid arm circumference, waist circumference and mid-thigh circumference were analyzed in this study.

Operational Definitions

Head circumference:

It measures the distance from above the eyebrows and ears; and around the back of head up to external occipital protuberance¹⁵.

Mid arm circumference:

It measures at the mid-point between the tip of the shoulder and the tip of olecranon process¹⁵.

Waist circumference:

It is a measurement around the abdomen at the level of the umbilicus¹⁵.

Mid thigh circumference:

It measures around the mid-point of thigh from 15cm proximal to the superior pole of patella¹⁵.

Before going into the procedure upon the study subjects; parents, teachers or legal guardian of each subject were informed about the nature of the study and informed written consent was obtained. A checklist was designed by the researcher to collect information regarding age, sex, parental heritage and the information supporting the inclusion and exclusion criteria. Subjects, parents or teachers were requested to help in positioning their children. All dimensions of every individual were measured by the same observer, with the same instrument to avoid any technical and/or interobserver error¹⁶. In this study each participant was measured twice for each dimension and the average value of the two measurements was taken, as the true value of the participant¹⁷. A third reading was taken, if the initial two measurements greatly differed and the two closer readings would then be used.

For measuring the head circumference, plastic measuring tape retracted, placed the free end at the midline of the forehead just above the superior orbital rims. Holding the free end in place with one hand and guided the tape around the head carefully with other, letting the tape unrolled slowly and being sure to pass the tape over the most protruded part of the occiput. When the tape reached the free end on the forehead, it overlapped and offset slightly to line up the zero and end point, reading was taken¹⁸.

To measure mid-arm circumference, child was standing with the elbow relaxed so that the right arm hangs freely to the side. The observer stood facing the children right side. The measuring tape was placed around the upper arm at the marked point perpendicular to the long axis of the upper arm. The tape was again held so that the zero end was held below the measurement value. The tape rests on the skin surface, but was not pulled tight enough to compress the skin. The mid-arm circumference is recorded to the nearest 0.1 cm¹⁵.

To measure waist circumference, observer stood on the childrens right side and places the measuring tape around the trunk in a horizontal plane at the highest point of the iliac crest of right side of the trunk. The recorder walked around the children to make sure that the tape was parallel to the floor and that the tape was snug, but did not compress the skin. The measurement was made at minimal respiration to the nearest 0.1 cm¹⁵.

To measure mid-thigh circumference, observer stood on the childrens right side and measuring tape was placed around the mid-thigh at the point that was marked around the mid-point of thigh from 15cm proximal to the superior pole of patella. The tape was positioned perpendicular to the long axis of the thigh with the zero end of the tape held below the measurement value. The tape rests firmly on the skin without compressing the skin. The thigh circumference was measured to the nearest 0.1 cm¹⁵.

The range, mean and standard deviation of values of the variables were calculated using computer-based programs Statistical Package for Social Science (SPSS version-22). Unpaired Students 't' test was done.

Results

Table I and Figure 1 shows range, mean value, and standard deviation of head circumference, mid arm circumference, waist circumference and mid-thigh circumference of children with autism spectrum disorder and normal children of Bangladesh. Children with Autism spectrum disorder have a significantly smaller head circumference when compared to normal children (t= 2.21, p<0.05). A significant difference was found in mid-thigh circumference. Children with Autism spectrum disorder have a significantly small mid-thigh circumference when compared to normal children (t=2.4, p<0.05). No significant difference between mid arm and waist circumferences of normal children and children with autism spectrum disorder.

Table I Comparison of head circumference, mid arm circumference, waist circumference and mid-thigh circumference of study subjects

| Variables | Normal children (Group A) Range | Children with Autism spectrum disorder (Group B) Range | Normal children (Group A) Mean ± SD (n=100) | Children with Autism spectrum disorder (Group B) Mean ± SD (n=100) | p value |
|-------------------------|---------------------------------|--|---|--|---------|
| Head circumference | 47.00-56.00 | 44.00-60.00 | 51.51±1.77 | 50.74±3.04 | <0.05* |
| Mid arm circumference | 13.50-33.00 | 10.00-35.00 | 20.29±3.99 | 19.73±5.12 | >0.05 |
| Waist circumference | 31.00 -90.00 | 45.00 – 100.00 | 60.10±9.53 | 60.37±13.47 | >0.05 |
| Mid thigh circumference | 19.50-67.00 | 13.00-53.00 | 35.62±7.11 | 33.02±8.20 | <0.05* |

*Significant.

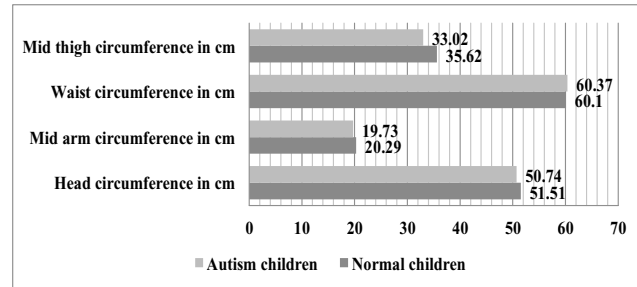


Figure 1 Comparison of head, mid arm, waist and mid thigh circumferences of study subjects.

Discussions

Autism spectrum disorder is diagnosed using DSM 5 criteria⁵. Although these criteria are useful for final confirmation, examination of the anthropometric variables by physical procedure will be also useful technique in the clinical assessment. Several studies on anthropometric variables of children with autism spectrum disorder in different racial origins were reported, but there is no such report yet on the Bangladesh.

Head circumference is one of the important physical findings in autism which varies significantly from the normal¹⁴. Various authors reported that head circumference and rates of macrocephaly are increased in autism^{19,20,21}. But a high degree of variability is present. In a study Gillberg & De Souza reported that only 1 in 10 of those with autistic disorder have macrocephalus²⁰. Although smaller head circumference and microcephaly associated with seizures and low intelligence was observed^{22,23,24}. Youssef et al and Fombonne et al reported that smaller head circumference and microcephaly as a phenotypic characteristic of autism^{25,26}. Fombonne et al reported finding of macrocephaly in 16.7% and microcephaly in 15.1% of their sample of children aged between 2 and 16 years with ASD²⁶. Miles et al. (2000) reported microcephaly in 7.3% of their observation¹⁴. In the present study (Table I) head circumference of Children with autism spectrum disorder was significantly smaller than that of normal children. Most autistic children with microcephaly were also reported to have associated medical disorders as well as mental retardation and were consistently predictive of a poorer outcome¹⁴. Many of the study subjects included in this study were from autism center having associated medical disorders and mental retardation and form a greater pool of sample size. As a result, microcephaly became a significant finding when compared to the normal children in this study. Head circumference growth in individuals with an Autism Spectrum Disorder (ASD) has been well characterized in the first two to three years of life or early childhood and reflects a period of acceleration

followed by a period of deceleration when compared with normal children. While this altered growth trajectory has been consistently found for head circumference. Studies have focused on infancy and early childhood, and no longitudinal data have been collected in older children with ASD². Brain growth in autism follows an abnormal pattern, with accelerated growth in early childhood that results in brain enlargement in childhood. Brain growth in children with autism is normal and appears to be due to a decrease in brain growth for these individuals at the same time that normal children are experiencing a slight increase¹⁹.

Eating is the most essential of human activities, necessary not only to sustain life but also to ensure proper growth. In this context, repetitive and restricted behavioral problems in children with ASD at meal times, including food selectivity, have been observed in many studies over the years. However, “food selectivity” is used in the literature to refer to a range of concepts including, for example, food refusal, a limited repertoire of accepted foods, high-frequency single food intake, excessive intake of a few foods²⁷. Atypical food behaviors and the abnormal lifestyle of individuals with ASD (With not only different levels of physical activity, but also idiosyncratic social skills and poor social interaction) are factors that imply risks of both excessive and insufficient intakes²⁸.

Mid arm, waist and mid thigh circumference means that taking the circumference of bone, muscle and subcutaneous fat layer together. In the present study (Table I) when the mean values of mid arm, waist and mid thigh circumference were compared between normal children and children with Autism Spectrum Disorder significant difference was found in mid thigh circumference ($t = 2.40, p < 0.05$). A smaller mid-thigh circumference in children with autism spectrum disorder is signifying malnourishment as compared to the normal children. Meguid et al stated that mid arm circumference is almost similar between Autism Spectrum Disorder children and normal children. Likely in this study, it is similar in children with Autism Spectrum Disorder and normal children¹².

Conclusion

The findings of the present study suggest that head circumference, mid arm circumference, waist circumference and mid-thigh circumference could be potentially useful for stratifying children with ASD for clinical diagnosis and nutritional assessment. So, more attention needs to be paid to assess anthropometric development and this aspect of development should be monitored as part of routine care of children with ASD.

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Disclosure

All the authors declared no competing interest.

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