

Growth Parameters of under 2-year-old Indian Children: A Comparison to WHO MGRS 2006 Charts

Venkat Sandeep Reddy, Rahul Jahagirdar, Ruma Deshpande

Department of Pediatrics, Bharati Vidyapeeth Medical College and Hospital, Pune, Maharashtra, India

Abstract

Context: Growth is an important biological process by which an individual reaches a point of complete physical development. Growth monitoring of a child is a very important utility to detect the deviation from normal growth. In India, for children below 2 years of age WHO multicentre growth reference study (MGRS) 2006 charts are being used for growth monitoring, which were prepared by measuring children from six different countries who were raised in optimum conditions of health and nutrition. **Aim:** This study was carried out to verify the appropriateness of the WHO MGRS 2006 charts to monitor the growth of Indian children who are below 2 years of age. **Settings and Design:** The study was carried out in a tertiary care hospital in Pune, Maharashtra. **Materials and Methods:** A total of 1947 children [1089 boys (55.9%)] were measured for weight, length and head circumference. Z score for each observed value was calculated according to the similar but gender-specific WHO MGRS 2006 growth charts. **Statistical Analysis Used:** The age- and sex-specific Z-scores or standard deviation scores along with prevalence were obtained for each study parameter using WHO standards. **Results:** A total of 24.08%, 21.31%, and 20.54% of the children were classified as underweight, stunted and microcephalic respectively when compared to the WHO MGRS 2006 growth charts. **Conclusion:** The WHO MGRS 2006 charts may not be appropriate for growth monitoring of Indian children below 2 years of age and there is a need formulate growth charts which can reflect the growth of Indian children.

Keywords: Growth charts, growth monitoring, head circumference, length, weight, WHO MGRS 2006

INTRODUCTION

Growth is the increase in the physical size of the body combined with increase in cell number and cell size. It is an important characteristic of all living organisms. It is a dynamic process which starts from the period of conception and continues in an orderly fashion. A child grows at a rate depending on his genetic potential. Final growth of a child also depends on nutritional, familial, emotional, sociocultural, community factors.^[1]

There are two periods of rapid growth in humans. The first phase of rapid growth is during infancy and it is a continuation of the fetal growth period. The second phase of rapid growth occurs during puberty.^[2]

Growth has a definite time limit. Any time that is lost during the initial rapid growth of life may prevent catch up growth and can affect the final growth of the child. Hence, growth monitoring is essential to detect any deviation of normal growth pattern.

Growth monitoring of all children throughout their childhood at regular intervals is an integral part of pediatric care as it helps pick up nutritional deficiencies, endocrinal disorders and chronic systemic illnesses at an early stage.^[3] Far more often, it is a practice that assures the parents as well as the pediatrician that the child is indeed growing well as good growth is an indicator for both physical and mental wellness. It is a quick, easy, inexpensive, noninvasive practice that provides valuable information about the health of the children.^[4] Growth assessment of many children studied collectively also provides an indirect measurement of the quality of life of a community or nation.

Address for correspondence: Dr. Rahul Jahagirdar,

Department of Pediatrics, 3rd floor, Bharati Hospital and Research Centre, Pune-Satara Road, Katraj-Dhankawadi, Pune - 411 043, Maharashtra, India.
E-mail: rjahagirdar@gmail.com

Submitted: 24-Oct-2019

Revised: 09-Dec-2019

Accepted: 26-Dec-2019

Published: 30-Apr-2020

Access this article online

Quick Response Code:



Website:
www.ijem.in

DOI:
10.4103/ijem.IJEM_570_19

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How to cite this article: Reddy KS, Jahagirdar R, Deshpande R. Growth parameters of under 2-year-old Indian children: A comparison to WHO MGRS 2006 charts. Indian J Endocr Metab 2020;24:176-80.

Growth charts are a graphical representation of a child's physical growth and development. They are of two types: (1) growth standards and (2) growth references.

Growth standards are prescriptive growth charts which give us information of how a population of children should grow physiologically with the best possible nutrition and environment, e.g. WHO 2006 growth standard for children under 5 years of age, which gives us the advantage of being able to compare children from different countries, races, ethnicity easily and objectively. Whereas growth references are descriptive growth charts which are made from values obtained from healthy children belonging to the same ethnic community, who are known to have grown in an environment of optimal nutrition and care, e.g. Agarwal growth charts (1994),^[5] revised Indian academy of pediatrics (IAP) growth charts (2015).^[6]

In India, WHO MGRS 2006 growth charts are being used for growth monitoring of Indian children who are below 2 years of age. The objective of MGRS charts was to devise standard growth charts which were applicable to all communities. MGRS was conducted in six different cities of the world – New York, Brazil, Norway, Ghana, New Delhi, and Bahrain.^[7] Only children who were brought up under best conditions of health and nutrition were included in the study.

Indian population is diverse. We have children belonging to various geography, culture, and religion.^[8] Children of various races have different stature and most of the them are small for age when compared to the American and European counterparts. Even though majority of children in India are at -1 to -2 SD on WHO growth charts, they lead a healthy life. Using these charts has resulted in overdiagnosing stunting and underweight of Indian children. These charts lead to an increase of 4.2 million in the estimated number of stunted children in India.^[9]

This study was done to know the appropriateness of WHO MGRS 2006 charts to monitor growth of under 2-year-old children in India.

MATERIALS AND METHODS

An observational cross-sectional study was carried out in a tertiary care hospital in Pune, India after Institutional ethical committee clearance was taken.

A total of 1947 children were included in the study. Of which 1089 (55.9%) were boys and 858 (44.1%) were girls.

Informed consent of either of the parents was obtained after explaining them the methods involved in the study in their own vernacular language.

Subjects were drawn from term, appropriate for gestational age (AGA) babies who attended well baby clinic or who came for immunization. Preterm babies, intrauterine growth restriction (IUGR) babies, babies with major congenital anomalies, genetic defects, chronic illnesses, and severely malnourished children were excluded.

Children belonging to upper and lower middle class (according to the modified Kuppuswamy scale) were included^[10] (upper class 1.2%, upper middle 42.5%, lower middle 46.7%, upper lower 8.1%, lower 1.5%).

Weight, length, and head circumference were measured. To avoid any interobserver variation, all measurements were taken by the same medical graduate. The investigators had 2-week training for performing accurate measurements according to the standard protocols.

Weight was measured to the second decimal in kilograms using a digital weighing machine manufactured by Zeal Pvt. Limited, standardized once a week with minimal measurable weight of 10 gm. The length was measured to the first decimal in centimeters using Shreyas infantometer with a minimal measurable length of 0.1 cm. The head circumference was measured to the first decimal in centimeters using a flexible tape with a minimal measurable length of 0.1 cm. Measurements were randomly repeated by the investigators to ensure accuracy.

Analysis of data

The data on categorical variables are shown as n (% of cases) and the data on continuous variables are presented as mean and standard deviation (SD). The age- and sex-specific Z-scores or standard deviation scores are obtained for each study parameter using WHO standard. All the results are shown in tabular form to visualize the statistically significant difference more clearly. Descriptive statistics and frequency tabulations were generated using statistical package for social sciences, version 16.

RESULTS

Study was conducted over a period of 2 years in a tertiary care hospital attached to a medical college. Out of 1947 children, 1089 (55.9%) were boys and 858 (44.1%) were girls. Their ages ranging from birth to 2 years of age.

The Z score for each observed value was calculated according to similar but gender-specific WHO 2006 growth charts [Table 1].

The Z scores thus calculated were compared to WHO charts and the prevalence of children who are underweight, stunted, and microcephaly were calculated [Tables 2-4].

DISCUSSION

Assessment of growth parameters is an important tool to evaluate the physical growth and nutritional status of a child. When the growth parameters are measured for a large cohort of children, who share many characteristics, such as ethnicity, socioeconomic, environment, etc. It gives an idea of how the children of an entire community are growing.

Growth charts are used to find out if children are in the normal or abnormal range and if they are in the abnormal range how far from normal are they.

Table 1: Description of anthropometry.

Age in months	Mean weight				Mean length				Mean head circumference			
	Boys		Girls		Boys		Girls		Boys		Girls	
	Mean (in kg)	SD	Mean (in kg)	SD	Mean (in cm)	SD	Mean (in cm)	SD	Mean (in cm)	SD	Mean (in cm)	SD
0-3	3.55	2.58	3.39	2.33	51.85	2.42	51.05	2.18	35.35	2.38	34.86	2.1
3-6	6.37	1.23	5.73	1.32	62.62	1.11	61.10	0.92	40.67	1.22	39.76	1.02
6-9	7.60	1.08	7.13	0.83	68.02	0.92	66.69	0.60	42.92	1.12	42.24	0.68
9-12	8.43	0.99	8.09	0.59	72.42	0.68	70.78	0.58	44.04	1.28	43.67	0.58
12-15	8.84	1.22	8.54	0.79	74.92	1.12	74.02	0.72	44.76	1.40	44.40	0.70
15-18	9.59	1.05	9.32	0.61	77.41	1.36	76.85	0.88	45.38	1.40	44.61	1.04
18-21	10.01	1.17	9.50	0.99	80.42	1.26	78.82	1.22	45.96	1.32	45.04	1.12
21-24	9.93	1.69	9.36	1.61	81.59	1.76	80.76	1.46	46.63	1.12	45.96	0.78

SD: Standard deviation

Table 2: Distribution of weight for age. Standard deviations on WHO charts

Gender	<-2SD, n (%)	-2--1 SD, n (%)	-1-0 SD, n (%)	>0 SD, n (%)
Boys	283 (25.99%)	386 (35.45%)	281 (25.80%)	139 (12.76%)
Girls	186 (21.68%)	268 (31.24%)	269 (31.35%)	135 (15.73%)

Table 3: Distribution of Length for age. Standard deviations on WHO charts

Gender	<-2SD n (%)	-2--1 SD n (%)	-1-0 SD n (%)	>0 SD n (%)
Boys	251 (23.05%)	327 (30.03%)	288 (26.45%)	223 (20.48%)
Girls	164 (19.11%)	214 (24.94%)	223 (25.99%)	257 (29.95%)

Table 4: Distribution of Head circumference for age. Standard deviations on WHO charts

Gender	<-2SD n (%)	-2--1 SD n (%)	-1-0 SD n (%)	>0 SD n (%)
Boys	284 (26.08%)	341 (31.31%)	315 (28.93%)	149 (13.68%)
Girls	116 (13.52%)	324 (37.76%)	254 (29.60%)	164 (19.11%)

In India, for children under 5 years of age, the growth charts used are WHO MGRS 2006 growth charts which were prepared by studying a large number of children who belong to six different countries of the world including India. A longitudinal follow-up of children from birth to 24 months of age and cross-sectional study of children aged 18 to 71 months of age were done. Data were collected from 8440 healthy infants who were exclusively breastfed. To ensure that the children with highest growth potentials were included, only children brought up under optimum conditions were selected for MGRS charts.^[11]

A growth chart should place 95% of its population between 3rd (-2 SD) to 97th (+2 SD) centile for it to be considered valid.^[12]

But when plotting children of India on these WHO MGRS 2006 growth charts, it depicts most of the Indian children as stunted or underweight for age (<-2SD).^[13]

Even though the majority of the children in India are at -1 to -2SD or less than -2 SD on the WHO growth charts, they lead a healthy life.

Comparing the growth of such children who are not raised in ideal conditions will result in over diagnosing stunted and underweight children on the WHO charts. These new charts lead to an increase of 4.2 million in the estimated number of stunted children.

In our study, there were 1947 (1089 boys) children, from birth to 2 years and after documenting the length, weight, head circumference; the growth parameters were evaluated on WHO MGRS charts.

Assessment by WHO MGRS charts by weight classified 283 (25.99%) and 186 (21.68%) of boys and girls respectively as underweight (<-2SD)^[14]; 386 (35.45%) and 268 (31.24%) of boys and girls respectively to be in-between -2 to -1 SD [Table 2].

Assessment by WHO MGRS charts by length classified 251 (23.05%) and 164 (19.11%) of boys and girls respectively as stunted (<-2SD)^[14]; 327 (30.03%) and 214 (24.94%) of boys and girls respectively to be in-between -2 to -1 SD [Table 3].

Assessment by WHO MGRS charts by head circumference classified 284 (26.08%) and 116 (13.52%) of boys and girls respectively as microcephalic (<-2SD)^[14]; 341 (31.31%) and 324 (37.76%) of boys and girls respectively to be in-between -2 to -1 SD [Table 4].

For a growth chart to be considered valid, 2.5% of the population should be lie below -2 SD, 95% of the population should lie between -2 SD and +2 SD, 2.5% of the population should lie above +2 SD. But our study showed a very high population lying below -2 SD [Table 5 and Figures 1, 2].

Hence, the WHO MGRS 2006 charts tend to judge more children in categories of wasted, underweight, and microcephaly.

Although, all these children have a low weight, length and head circumference for age when compared to the WHO growth charts, all these children are clinically well and are leading a

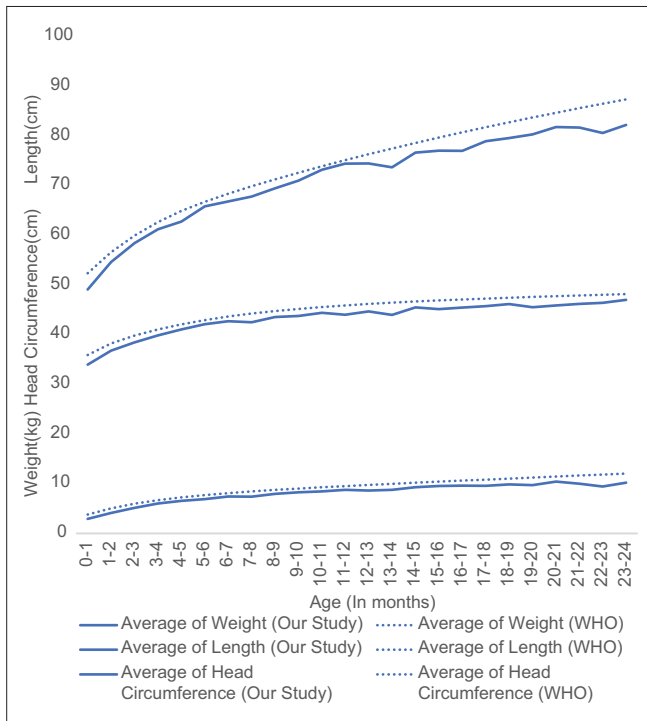


Figure 1: Comparison of anthropometry of boys in our study to WHO MGRS

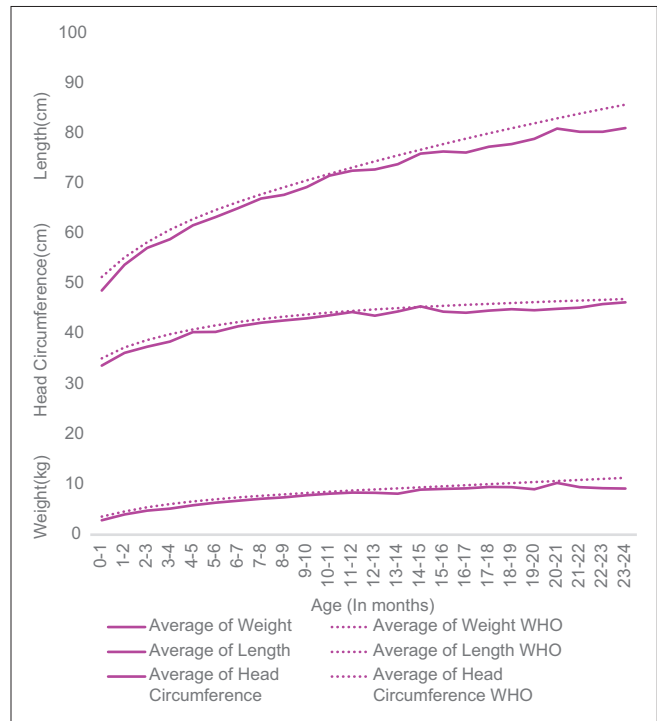


Figure 2: Comparison of anthropometry of girls in our study to WHO MGRS

Table 5: Percentage of our study lying below –2 SD

Growth Parameter	Boys	Girls
Weight for age	283 (25.99%)	164 (19.11%)
Length for age	251 (23.05%)	164 (19.11%)
Head Circumference for age	284 (26.08%)	116 (13.52%)

normal healthy life. Our study shows that the Indian children are over diagnosed with conditions of underweight, stunting, and microcephaly when plotted on a WHO MGRS charts. Therefore, caution needs to be exercised while using WHO MGRS growth charts for Indian children when labeling them as underweight, stunted, or microcephalic.

However, our study has a limitation that the babies included in our study were predominantly breast fed. But data of how long the babies were exclusively breast fed were not collected.

CONCLUSION

Considering Indian children below 1st centile curve on WHO MRGS 2006 charts as underweight instead of 3rd centile curve on the charts may help in preventing overdiagnosis of underweight, stunting and microcephaly in India.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients

understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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