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**Original Research Article**

# Cerebral palsy specific growth charts for Indian children: need of the hour

**Govind Choudhary, Nusrat Rahim Inamdar*, Anupama Mauskar**

Department of Pediatrics, HBT Medical College and Dr. R. N. Cooper Hospital, Mumbai, Maharashtra, India

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***Correspondence:**
Dr. Nusrat Rahim Inamdar,
E-mail: nusratinamdar@gmail.com



## ABSTRACT

**Background:** Children with cerebral palsy (CP) are generally undernourished and growth retarded. The nutritional assessment and anthropometry have important role in management of these problems. Reference growth curves for Indian children with CP may be helpful to clinicians and beneficial to children for better assessment of nutritional status and to monitor growth. This study was conducted to compare the anthropometric inferences derived from specific growth curves for CP developed by centers for disease control (CDC) with that of using WHO and IAP growth curves.
**Methods:** Cross sectional observational study conducted on 40 children with CP aged 2 to 12 year. Through universal sampling. Anthropometric variables measured and plotted on age and gender specific growth curves for cerebral palsy and on WHO / IAP growth curves. Nutritional assessments on these growth curves are then compared.
**Results:** Number of underweight children were more on WHO/IAP growth curves 52.5% (n=21) compared to CP specific growth curves 20% (n=8) (p=0.002) similarly, number of stunted children were more on WHO/IAP growth curves (40% versus 0%) compared to CP specific growth curves (p=0.0001) both being statistically significant. No significant difference was seen on comparing BMI (p=0.067).
**Conclusions:** Significant difference in nutritional status is observed when anthropometric variables are compared on two curves (CP specific versus WHO/IAP curves). Applying WHO/IAP growth curves, to assess the growth of children with cerebral palsy may not be appropriate and may have fallacies with interpretations of growth and nutritional status. Apart from nutrition, functional status and co morbidities also play a vital role in deciding nutritional status. Disease specific or standardized growth charts for Indian children with CP may play an important role in early diagnosis and management of growth faltering.

**Keywords:** Cerebral palsy, Anthropometry, Growth curves, Nutrition, GMFCS

## INTRODUCTION

Disorders of growth and nutrition are common health problems in children with cerebral palsy (CP).[1] These problems add losses to motor and cognitive development, socialization, psychological function, use of health services, need for hospitalizations, and overall health.[2] They also represent challenges in care of children with CP, for paediatricians. Conditions like impaired oral-motor function, temporomandibular joint contractures, vomiting, and aspiration pneumonia associated with gastroesophageal reflux, contributes to malnourishment.[3]

Growth charts are standard tools for monitoring paediatric growth, development, and overall health. Specific and descriptive growth charts can help medical teams through early identification of nutritional and metabolic problems of growth so that effective intervention can be provided.[4,5] Diagnosis-specific growth curves have been developed for conditions, such

as Down syndrome and Turner syndrome where genetic abnormality directly influences stature.[6-9] Reference growth curves for children with CP may be helpful to clinicians and beneficial to children; however, any representative sample is heterogeneous and likely to include many children with differing degrees of acute and chronic malnutrition and, possibly, GH deficiency.[10] The CP charts demonstrate significant deviations from general population reference centiles, with deviations increasing with age and with severity of functional disability (as measured by Gross Motor Function Classification System [GMFCS] levels). The patterns of growth in CP are more heterogeneous than in conditions for which a specific genetic cause of altered growth is present. Many recently developed growth charts for children with CP account for this heterogeneity by stratifying according to GMFCS level.

There is need of more accurate anthropometric measurements, so as to help in providing adequate and individualized nutritional care and counselling and improving quality of life for children and adolescents with CP and their families. Studies to define methods and specific references more appropriate to assess growth in individuals with CP have been performed in recent years, and the improvement in the knowledge and practice of nutrition rehabilitation measures have led to increased survival in CP.[11] However, most of these studies were conducted in developed countries; studies evaluating nutritional status in CP in developing countries are scarce.

Thus, this study is undertaken to determine the nutritional assessment of children with CP, to compare the anthropometric inferences derived from specific growth curves for CP developed by Centers for Disease Control (CDC) with that of using WHO and IAP growth curves.

## METHODS

A cross sectional observational study was conducted in Department of Paediatrics, HBT Medical College & Dr. R. N. Cooper Municipal General Hospital, Mumbai a tertiary care centre over a period of 13 months (June 2019 to June 2020). Inclusion criteria: Universal sampling i.e. all the children with established diagnosis of static encephalopathy i.e. CP, aged 2 to 12 years visiting the health facility for outpatient as well as in patient services were enrolled after taking informed consent of their parents. Children with syndromic association, chromosomal anomalies, dysmorphism, chronic systemic illness like congenital heart disease, chronic kidney disease and structural malformation like hydrocephalus, meningomyelocele, which can affects growth and nutrition and children not meeting the inclusion criteria were excluded from the study group. Children's demographic details, complaints, anthropometry were noted in predesigned case Performa. Total 40 children were enrolled in this study. All were classified according to topographical classification of CP. Weight measured in kilograms on a digital scale, height measured in centimetre using a stadiometer, measurement of height in patients with cerebral palsy is difficult due to the presence of skeletal contractures, and inability of many of those patients to stand. Thus, for such cases the height is calculated from the knee height using the following:

$Stevenson's\ equation: height = (2.69 \times knee\ height) + 24.2.$[12]

The knee height measured, using the measuring tape, with the knee and ankle being bent at a 900. The knee height is the distance between heal and the anterior surface of the thigh over the femoral condyle.

Body mass index (BMI) is calculated according to the equation:

BMI = weight (kg)÷height (m)2

Children were allocated into five subgroups according to Gross Motor Functional Classification System (GMFCS) based on the severity of motor impairment, progressively varying from the milder level I to the most severe level V. In this study, subjects are allocated at different levels based on motor acquisition.[13]

I. Walks without limitations / walk well alone at least 20 feet, balances well.

II. Walks with limitations / Walks with support or unsteadily alone at least 10 feet.

III. Walks using a hand-held mobility device/ Crawls, creeps or scoots but does not walk.

IV. Self-mobility with limitations; may use powered mobility / Does not walk, crawl, creep or scoot; does not feed self; No feeding tube.

V. Wheelchair bound / does not feed self; Feeding tube.

The anthropometric data were plotted on age and gender specific growth curves for CP (according to GMFCS criteria) and on WHO/IAP growth curves and nutritional assessment are then compared. A predesigned questionnaire was used to collect the data. Data were represented in frequencies, percentage, tables and charts. Mean and standard deviation of quantitative variable is shown.

Parameters are used for comparison are: weight for age (weight/age), height for age (height/age), and BMI.

### *Interpretations from CDC cerebral palsy specific growth curves*

Nutritional deficit (malnourished) considered in those whose data were below the 10th percentile; normal weight in those between the 10th and 50th percentile; at

risk of overweight between the 50th and the 90th percentile; and overweight considered in those >90th percentile.

**Table 1: Interpretations from WHO/IAP growth curves.**

| Z Score (Percentile) | Height for age | Weight for age | BMI for age |
|---|---|---|---|
| **>3 (99)** | May be abnormal | May be abnormal (Use BMI) | Obese |
| **>2 (97)** | Normal | Use BMI | Overweight |
| **>1 (85)** | Normal | USE BMI | Risk of overweight |
| **0 (50)** | Normal | Use BMI | Normal |
| **<-1 (15)** | Normal | Normal | Normal |
| **<-2 (3)** | Stunted | Underweight | Wasted |
| **<-3 (1)** | Severely stunted | Severely underweight | Severe wasted |

## RESULTS

Out of 40 children enrolled in this study 18 (45%) were of 2-5 years and 22 (55%) in 5-12 years age group (Mean=5.5 years, SD=2.66). Of these 19 (47.50%) were male and 21 (52.50%) were females.

On classifying all children based on their functional status according to Gross Motor Functional Classification System (GMFCS) 16 (40%) were in GMFCS level V, 12 (30%) children in the level I, 5 (12.5%) in the level III, 5 (12.5%) in the level IV and 2 (5%) in the level II.

On plotting weight for age on the CP specific growth curves, 8 (20%) children were underweight, 21 (52.50%) were of normal weight, 10 (25%) were at risk of overweight and 1 (2.50%) child was overweight. while, on the WHO/IAP growth curves, 21 (52.5%) children were underweight, 18 (45%) were normal weight, 1 (2.5%) child was at risk of overweight. (p=0.002).

**Table 2: Weight for age (CP specific versus WHO/IAP growth curves).**

| Variable | Groups | CP Specific | | WHO / IAP | |
|---|---|---|---|---|---|
| | | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| **Weight** | Underweight | 8 | 20.00 | 21 | 52.50 |
| | Normal weight | 21 | 52.50 | 18 | 45.00 |
| | At risk of overweight | 10 | 25.00 | 1 | 2.50 |
| | Overweight | 1 | 2.50 | 0 | 0.00 |
| **Total** | | 40 | 100 | 40 | 100 |
| **$X^2$ = 14.42, p=0.002*** | | | | | |

*Significant

**Table 3: Height for age (CP specific v/s WHO/IAP growth curves).**

| Variable | Groups | CP Specific | | WHO / IAP | |
|---|---|---|---|---|---|
| | | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| **Height** | Stunted | 0 | 0.00 | 16 | 40.00 |
| | Normal | 37 | 92.50 | 24 | 60.00 |
| | Above normal | 3 | 7.50 | 0 | 0.00 |
| **Total** | | 40 | 100 | 40 | 100 |
| **$X^2$ = 21.77, p<0.0001** | | | | | |

**Table 4: BMI for age (CP specific v/s WHO/IAP growth curves).**

| Variable | Groups | CP specific | | WHO / IAP | |
|---|---|---|---|---|---|
| | | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| **BMI** | Wasted | 9 | 36.00 | 5 | 20.00 |
| | Normal | 10 | 40.00 | 15 | 60.00 |
| | At Risk of overweight | 6 | 24.00 | 2 | 8.00 |
| | Overweight / Obese | 0 | 0.00 | 3 | 12.00 |
| **Total** | | 25 | 100 | 25 | 100 |
| **$X^2$ = 7.14, p = 0.067** | | | | | |

On plotting Height for age on the CP specific growth curves, 37 (92.5%) children were of normal height. While, on the WHO / IAP growth curves, 16 (40%) children were stunted and 24 (60%) were of normal height (p<0.0001).

On comparing BMI, on CP specific growth curves 9 (36%) children were wasted, 10 (40%) had normal BMI, 6 (24%) were at risk of overweight. While, on WHO/IAP growth curves, 5 (20%) children were wasted, 15 (60%) had normal BMI, 2 (8%) were at risk of overweight and 3 (12%) were overweight / Obese (p=0.067).

## DISCUSSION

Cerebral palsy is most common form of chronic motor disability that begins in childhood. Data from the Centres for Disease Control and Prevention indicate that the incidence is 3.6 per 1000 children with a male: female ratio of 1.4:1. The prevalence of CP has increased in recent times as a result of the enhanced survival of very premature infants weighing <1000 gm, who go on to develop CP at a rate of approximately 15 per 100.[14]

This study was conducted with the purpose of finding nutritional assessment tool with better clinical correlation for children with cerebral palsy in India and also to emphasize importance of early identification and management of certain co morbidities.

We observed that there is significant difference in nutritional assessment when we compared anthropometric variables on CP specific curves with that of curves for Indian general population (WHO/IAP). WHO/IAP growth curve overestimates number of children with nutritional deficit (52.5% vs 20%) while underestimate normal weight (45% versus 52.5%), at risk of overweight (2.5% versus 25%) and overweight (0% versus 2.5%) children compared to CP specific growth curve. Similarly, number of stunted children were more on WHO/IAP growth curves (40% versus 0%) compared to CP specific growth curves (p=0.0001)both being statistically significant. No significant difference was seen between the BMI comparison of (CP specific versus WHO/IAP) growth curves (p=0.067). We also observed that types of cerebral palsy and functional status of children with CP largely affect their nutritional status and co morbidities in them.

In study by Araújo et al similar results were obtained, on plotting weight of CP child on CDC curves for general population, number of underweight children were more (51% versus 10%) compared to when plotted on CP specific curves. Similarly plotting height of CP child on CDC curves for general population number of children with height <10th centile were more (51% versus 1%) compared to when plotted on CP specific curves.[15]

This difference in nutritional status on two curves in our study can be explained by fact that children with CP are generally malnourished (underweight, stunted) due to varieties of reasons like feeding difficulties, frequents infections, co-morbidities and poor gross motor functional status. On plotting anthropometric variables of these children on WHO/IAP growth curves developed for general population, they tends to fall on growth centiles and results in over estimation of malnutrition.

Also, as the CP specific curve developed by CDC are designed on reference population of children with cerebral palsy who were clients of the California Department of Developmental Services. This difference might be due to inherited difference in growth potential and anthropometry in different racial groups and also due to more prevalence of malnutrition in Indian population in general.

Our study findings are supported by a similar British study. Wright et al in their study on British children with CP plotted the anthropometric data of British children on CP specific charts constructed using data for Californian patients, and compared these data with conventional local British charts.[16] They concluded that British children with severe CP seem relatively very small when their growth data are plotted on non-CP charts, but their data for weight and body mass index fit well to US CP charts and reasonably well for height.

### *Limitations*

We have used CDC CP specific growth curves for comparison in our study, which are not standardised for Indian children. Duration of disability since diagnosis is not studied, which can affect the present nutritional status of child. Nutritional status of children is not correlated with socioeconomic status of families. Being a Government tertiary care institute in developing country like India, majority of patients enrolled in this study were of lower socioeconomic status. Lower socioeconomic status limits resources available for nutrition, healthcare, and psychosocial support. It also affects health seeking behaviour of families in developing countries especially in Indian population. Sample size of this study is small which could be increased if study was done in community and not restricted to children visiting healthcare facility.

## CONCLUSION

Assessing nutritional status appropriately as per the functional status of children remains a challenge for treating paediatrician. The growth charts as per functional status of children with CP are being used by western countries; however they are not available for children in developing countries yet. Applying Indian reference growth charts developed by IAP for general population,

to assess the growth of children with cerebral palsy may not be appropriate and may have fallacies with interpretations of growth and nutritional status of these children. Our study emphasizes the need for new growth curve specific to Indian children with cerebral palsy or to standardise existing tools, according to functional status of children with CP. It will help the physicians and other healthcare workers for early intervention and better utilisation of resources for these children.

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