# Comparison between the Local Growth References of Indian preschool children aged 0-36 months and WHO child growth standards, 2006

Ch. Lakshmi Sujatha[a] & M. Vishnu Vardhana Rao[b]

**Abstract**

*The Present Paper describes the construction of growth reference curves for preschool children of both sex aged 0-36 months of India to establish national growth reference curves which could be used for prevalence studies of malnutrition. Anthropometric data from the National Family Health Survey (NFHS-3), 2005-2006 secondary data of India were taken and state-of-the-art statistical methods were used to construct the local growth reference curves, i.e. Box- Cox power exponential (BCPE) method with appropriate diagnostic tool for the selection of best models, were applied to this local growth reference data. Our objective is to establish growth reference curves for weight for age, height for age and weight for height of girls and boys aged 0-36 months of India and comparing them with that of WHO, CGS 2006.*

**Key Words:** Local Growth References**,** WHO, CGS 2006, Box- Cox power exponential (BCPE) method

[a] Department of Statistics Nizam College Osmania University Hyderabad (Telangana), India

Lakshmisujatha25@gmail.com

[b] Scientist-F, NIN, Tarnaka, Hyderabad (Telangana), India

## Introduction

As genetic, epigenetic and racial differences affect growth, it is logical to determine local reference charts in the evaluation of health and growth disorders [(1)]. In 2006 WHO launched new child growth standards (CGS) [(2)] in which many statistical and ethnic limitations of previous child growth references have been well taken care. However, WHO-CGS, 2006 does not provide information about actual growth in a given country and will not eliminate the need for prevalence studies [(3)]. The aim of the present study was to assess how well Indian preschool children match with, or diverge from WHO-CGS, 2006. It was also observed that different parts of the world studies were made on how their regional growth references differed from WHO-CGS, 2006 [(3-8)]. The issue is more sensitive when it concerns with preschool children, where early intervention is most advisable. The present study aimed at a study which reveals cut-off points of height for age, weight for age and weight for height for growth monitoring of Indian preschool children aged 0-36 months and comparing them with WHO CGS, 2006.

## Methods

### Local growth reference data

Usually the reference data on body height and weight cut-off points for growth monitoring and targeting of intervention are based on studies of affluent well-nourished and healthy local populations. The local growth reference data of Indian preschool children is taken to be the same as that of what is considered by Lakshmi Sujatha et al[(19)].

### The Generalized additive model for location scale and shape (GAMLSS) method [(10- 16)]:

The BCPE method, with curve smoothing by cubic splines and penalized B-splines, was selected as the approach for constructing the local growth reference curves. This method is included in a broader methodology, the GAMLSS, which offers a general framework that includes a wide range of known methods for constructing growth curves. The GAMLSS allows for modeling the mean (or median) of the growth variable under consideration as well as other parameters of its distribution that determine scale and shape. Various kinds of distributions can be assumed for each growth variable of interest, from normal to skewed and/or kurtotic distributions. Several smoothing terms can be used in generating the curves, including cubic splines, lowess (locally weighted least squares regression), polynomials, power polynomials and fractional polynomials.

The BCPE distribution is described as

Let Y be a positive random variable having, a BCPE, denoted by BCPE ($\mu$, $\sigma$, $\upsilon$, $\tau$), defined through the transformed random variable Z given by

$$Z = \frac{1}{\upsilon\sigma}\left[\left(\frac{Y}{\mu}\right)^{\upsilon} - 1\right] \quad \text{if } \upsilon \neq 0 \qquad (1)$$

$$= \frac{1}{\sigma}\log\left(\frac{Y}{\mu}\right) \quad \text{if } \upsilon = 0$$

For $0<Y<\infty$, where $\mu>0$ and $\sigma>0$, and where the random variable Z is assumed to follow a standard power exponential distribution with power parameter, $\tau>0$, treated as a continuous parameter.

The probability density function of Z, a standard power exponential variable, is given by

$$f_Z(z) = \frac{\tau}{c^{2\left(1+\frac{1}{\tau}\right)}\left(\frac{1}{\tau}\right)} e^{\left\{-0.5\left|\frac{z}{c}\right|^{\tau}\right\}}$$ for -

$\infty < z < \infty$ and $\tau > 0$, where $c^2 = 2^{\frac{-2}{\tau}}\left(\frac{1}{\tau}\right)\left(\frac{3}{\tau}\right)^{-1}$

For Z mean is 0 and standard deviation is 1.

i) for $\tau = 1$ ,the density function of Z reduces to

$$f_z(z) = \frac{e^{-\sqrt{2}|z|}}{\sqrt{2}} \quad ; -\infty < z < \infty$$

And is that of a Laplace distribution (two sided exponential).

ii) for $\tau = 2$, the density function of Z reduces to

$$f_z(z) = \frac{e^{-z^2}}{\sqrt{2\pi}} \quad ; -\infty < z < \infty$$

And is that of standard normal distribution.

iii) for $\tau \to \infty$ uniform distribution is the limiting distribution of Z.

from (1) ,the probability density function of Y, a BCPE(μ, σ, υ, τ) random variable, is given by

$$f_y(y) = f_z(z)\left|\frac{dz}{dy}\right| = \frac{y^{\upsilon-1}}{\mu^{\upsilon}\sigma} f_z(z)$$

The simplified notation to describe a particular model within the class of the BCPE method is:

BCPE(x=x, df(μ)=n1, df(σ)=n2, df(ν)=n3, df(τ)=n4),

where *df(·)* are the degrees of freedom for the cubic splines smoothing the respective

parameter curve and *x* is age (or transformed age) or length/height. Note that when *df(·)=1*, the smoothing function reduces to a constant and when *df(·)=2*, it reduces to a linear function. The GAMLSS software was used to construct the WHO child growth standards. The main selected diagnostic tests and tools are available in this software. The Box-Cox-power-exponential (BCPE) distribution with four parameters — μ (for the median), σ (coefficient of variation), ν (Box-Cox transformation power) and τ (parameter related to kurtosis) — was selected for constructing the Local Growth Reference curves. The BCPE is a flexible distribution that offers the possibility to adjust for kurtosis, thus providing the framework necessary to test if fitting the distribution's fourth moment improves the estimation of extreme percentiles.

**Results**

The specifications of the BCPE models that provided the best fit to generate the local growth reference curves for Indian preschool children aged 0- 36 months were taken same as that of what is considered by Lakshmi Sujatha et al **(19)**.

The local growth reference centile charts were constructed (figures 1-6) and local growth reference centiles were computed (tables 1-6) using the best BCPE models for weight for age, height for age and weight for height of both sexes using the GAMLSS package. The above models were checked for goodness of fit using wormplots (17) and Q test (18) and the models came up to be reasonably good as we find flat worms . In a wormplot a flat worm indicates that the data follow the assumed distribution in that age group. So the aim of the model fitting process is to 'tame the worms'. If all worms are reasonably flat and are within chance variation, then the model fits quite well.

*Figure1: The cut-offs curves WHO and that of local growth reference (Indian pre school children) using GAMLSS method for data of boys weight for age. (aged 0-36 months).*

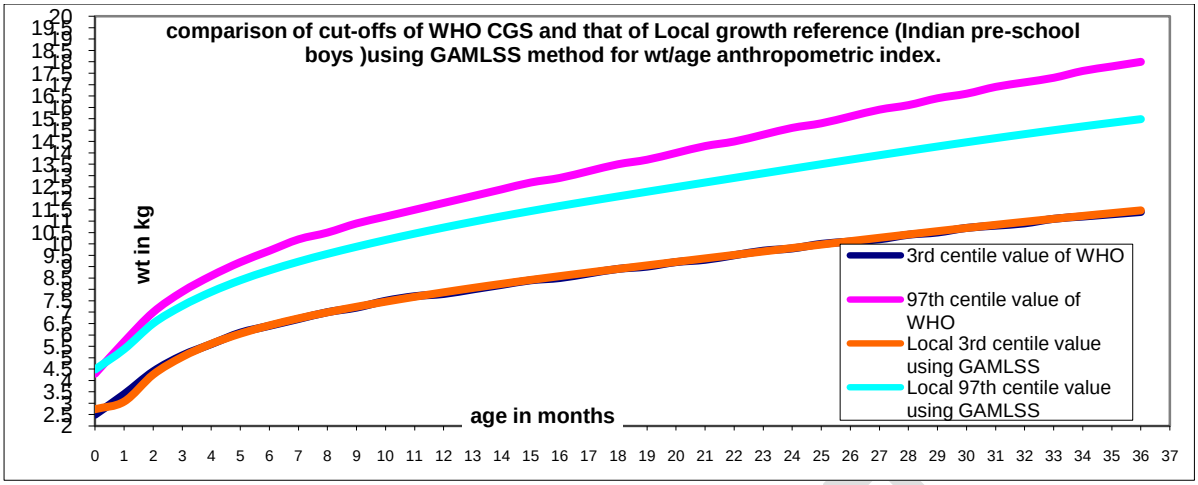


*Figure2: The cut-offs curves WHO (red thick upper and lower curves) and that of Indian pre school children data using GAMLSS method (blue thick upper and lower curves) for data of boys height for age. (aged 0-36 months).*

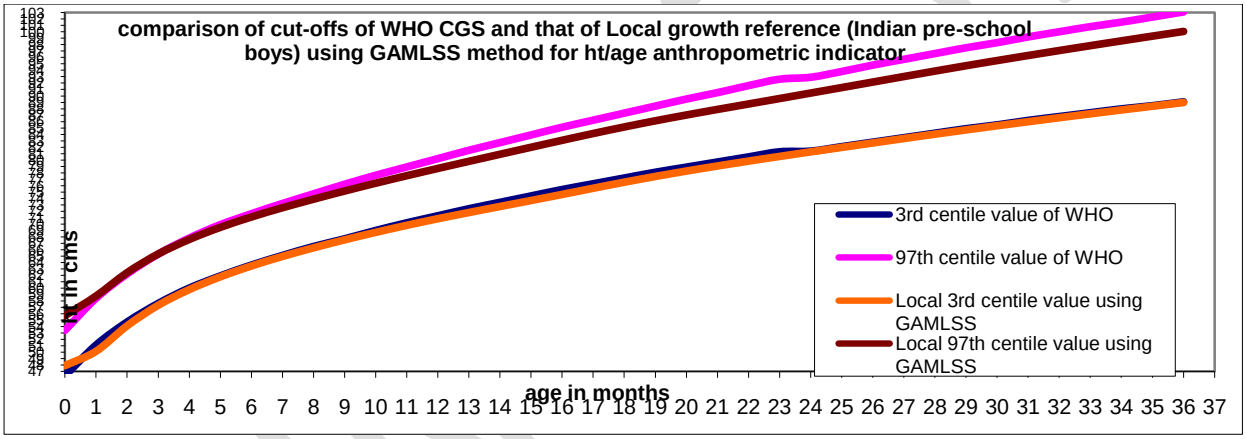


*Figure3: The cut-offs curves WHO CGS and that of local growth reference (Indian pre school children) using GAMLSS method for data of boys weight for height (48cm-103cm).*

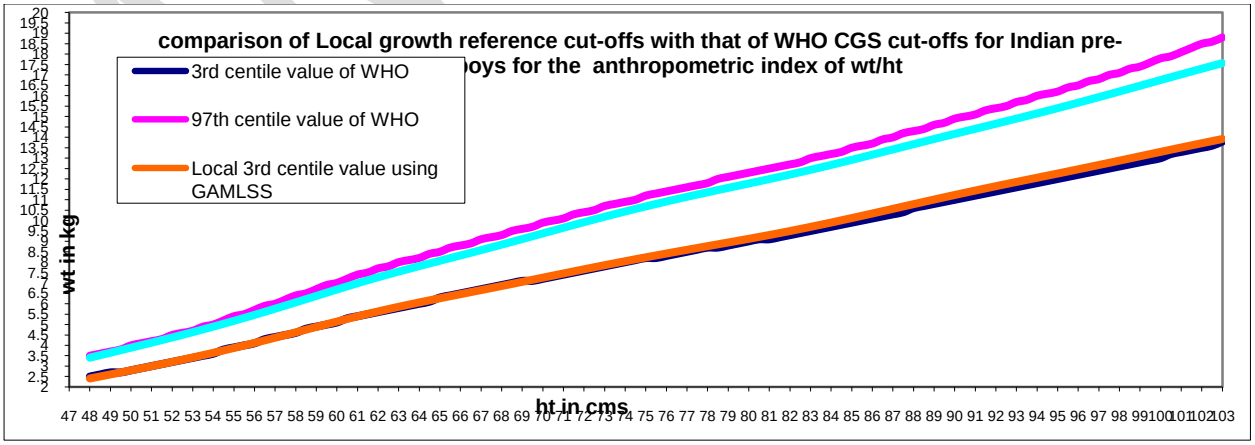


*Figure4: The cut-offs curves WHO and that of Local growth reference (Indian preschool children) using GAMLSS method for data of girls weight for age (aged 0-36 months).*

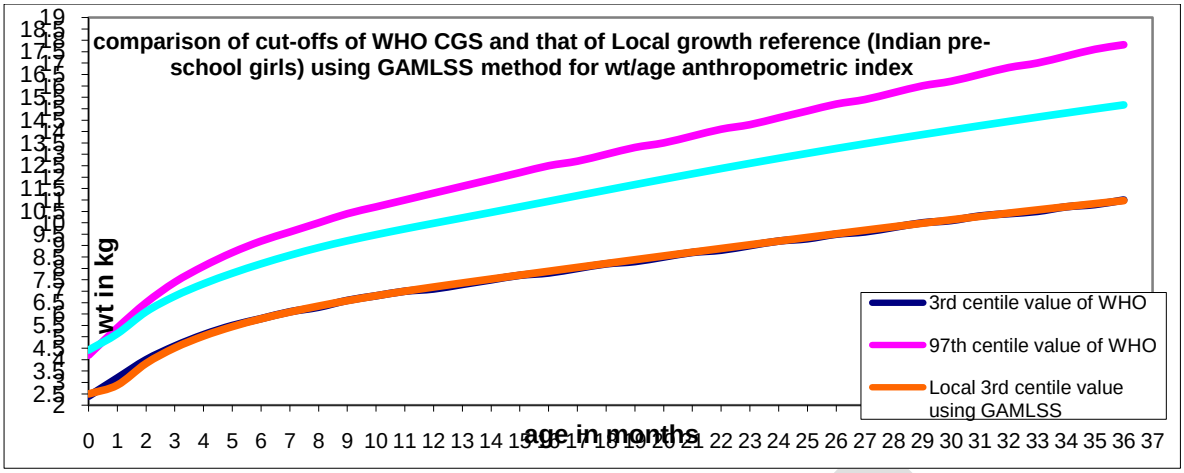


*Figure5: The cut-offs curves WHO and that of Local growth reference (Indian preschool girls) data using GAMLSS method for height for age (aged 0-36 months).*

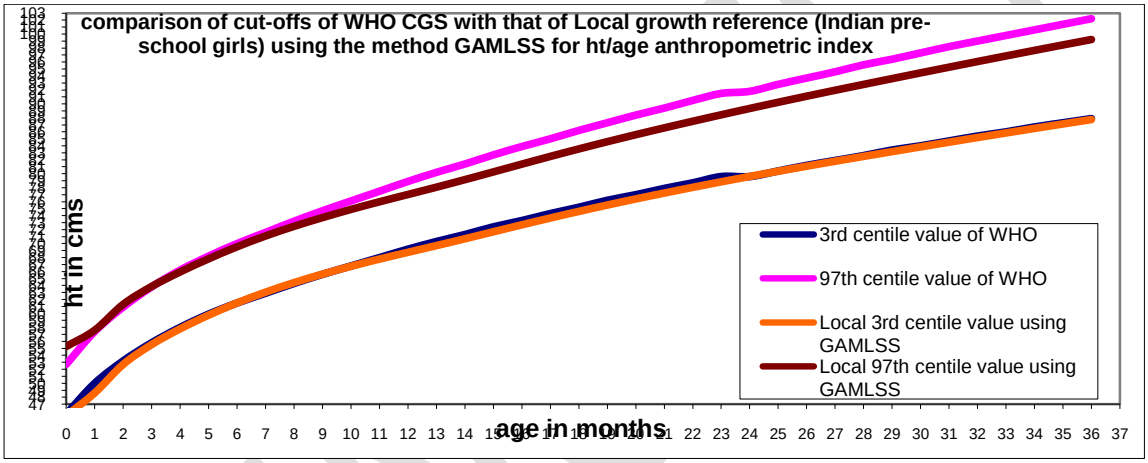


*Figure6: The cut-offs curves WHO and that of Local growth reference (Indian preschool children) using GAMLSS method for data of girls weight for height (48 cm-103 cm).*

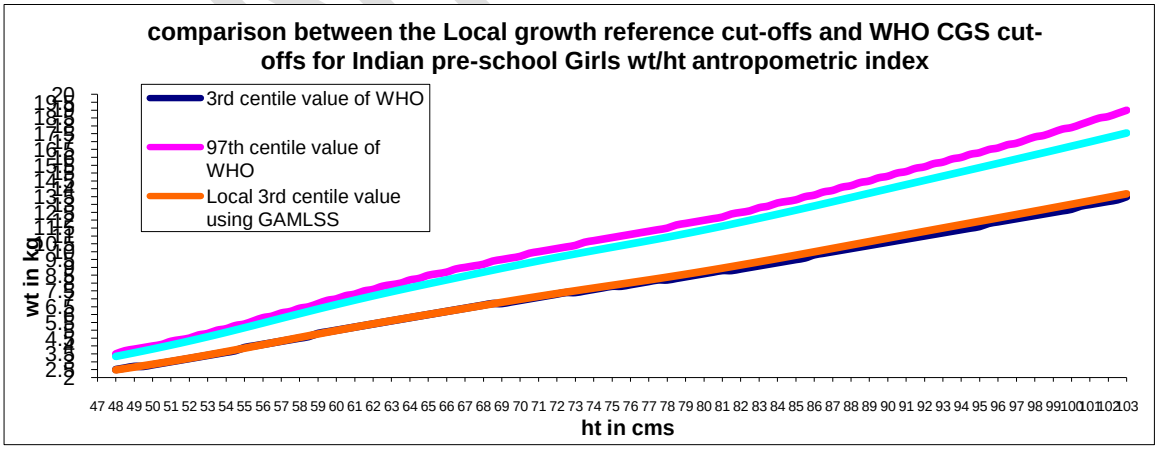


*Table 2: $3^{rd}$, $5^{th}$ , $10^{th}$ , $20^{th}$ , $30^{th}$ , $40^{th}$ , $50^{th}$ , $60^{th}$ , $70^{th}$ , $80^{th}$ , $90^{th}$ , $95^{th}$, $97^{th}$ centiles for Indian preschool boys aged 0-36 months data for weight for age.*

| age | 3rd centile | 5th centile | 10th centile | 20th centile | 30th centile | 40th centile | 50th centile | 60th centile | 70th centil | 80th centil | 90th centil | 95th centil | 97th centil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.7 | 2.8 | 2.9 | 3.0 | 3.2 | 3.3 | 3.5 | 3.6 | 3.8 | 4.0 | 4.2 | 4.4 | 4.5 |
| 1 | 3.1 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 4.1 | 4.3 | 4.5 | 4.7 | 5.0 | 5.2 | 5.4 |
| 2 | 4.3 | 4.3 | 4.5 | 4.7 | 4.9 | 5.0 | 5.2 | 5.3 | 5.5 | 5.7 | 6.1 | 6.3 | 6.5 |
| 3 | 5.0 | 5.1 | 5.3 | 5.4 | 5.6 | 5.8 | 5.9 | 6.1 | 6.3 | 6.5 | 6.8 | 7.1 | 7.3 |
| 4 | 5.6 | 5.7 | 5.8 | 6.0 | 6.2 | 6.3 | 6.5 | 6.7 | 6.8 | 7.1 | 7.4 | 7.7 | 7.9 |
| 5 | 6.1 | 6.1 | 6.3 | 6.5 | 6.6 | 6.8 | 6.9 | 7.1 | 7.3 | 7.6 | 7.9 | 8.2 | 8.4 |
| 6 | 6.4 | 6.5 | 6.6 | 6.8 | 7.0 | 7.1 | 7.3 | 7.5 | 7.7 | 8.0 | 8.3 | 8.6 | 8.8 |
| 7 | 6.7 | 6.8 | 6.9 | 7.1 | 7.3 | 7.5 | 7.6 | 7.8 | 8.1 | 8.3 | 8.7 | 9.0 | 9.2 |
| 8 | 7.0 | 7.1 | 7.2 | 7.4 | 7.6 | 7.7 | 7.9 | 8.1 | 8.4 | 8.6 | 9.0 | 9.3 | 9.6 |
| 9 | 7.2 | 7.3 | 7.5 | 7.7 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.9 | 9.3 | 9.6 | 9.9 |
| 10 | 7.5 | 7.5 | 7.7 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.9 | 9.2 | 9.6 | 9.9 | 10.2 |
| 11 | 7.7 | 7.8 | 7.9 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.4 | 9.8 | 10.2 | 10.5 |
| 12 | 7.9 | 8.0 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.4 | 9.7 | 10.1 | 10.5 | 10.7 |
| 13 | 8.1 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.3 | 9.6 | 9.9 | 10.3 | 10.7 | 11.0 |
| 14 | 8.2 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.3 | 9.5 | 9.8 | 10.1 | 10.6 | 11.0 | 11.2 |
| 15 | 8.4 | 8.5 | 8.6 | 8.9 | 9.1 | 9.3 | 9.5 | 9.7 | 10.0 | 10.3 | 10.8 | 11.2 | 11.4 |
| 16 | 8.6 | 8.7 | 8.8 | 9.0 | 9.2 | 9.4 | 9.7 | 9.9 | 10.2 | 10.5 | 11.0 | 11.4 | 11.7 |
| 17 | 8.7 | 8.8 | 9.0 | 9.2 | 9.4 | 9.6 | 9.8 | 10.1 | 10.4 | 10.7 | 11.2 | 11.6 | 11.9 |
| 18 | 8.9 | 9.0 | 9.1 | 9.4 | 9.6 | 9.8 | 10.0 | 10.3 | 10.6 | 10.9 | 11.4 | 11.8 | 12.1 |
| 19 | 9.1 | 9.1 | 9.3 | 9.5 | 9.7 | 10.0 | 10.2 | 10.4 | 10.7 | 11.1 | 11.6 | 12.0 | 12.3 |
| 20 | 9.2 | 9.3 | 9.5 | 9.7 | 9.9 | 10.1 | 10.4 | 10.6 | 10.9 | 11.3 | 11.8 | 12.2 | 12.5 |
| 21 | 9.4 | 9.5 | 9.6 | 9.8 | 10.1 | 10.3 | 10.5 | 10.8 | 11.1 | 11.5 | 12.0 | 12.4 | 12.7 |
| 22 | 9.5 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.7 | 11.0 | 11.3 | 11.6 | 12.2 | 12.6 | 12.9 |
| 23 | 9.7 | 9.8 | 9.9 | 10.2 | 10.4 | 10.6 | 10.9 | 11.1 | 11.4 | 11.8 | 12.4 | 12.8 | 13.1 |
| 24 | 9.8 | 9.9 | 10.1 | 10.3 | 10.5 | 10.8 | 11.0 | 11.3 | 11.6 | 12.0 | 12.5 | 13.0 | 13.3 |
| 25 | 10.0 | 10.1 | 10.2 | 10.5 | 10.7 | 10.9 | 11.2 | 11.5 | 11.8 | 12.2 | 12.7 | 13.2 | 13.5 |
| 26 | 10.1 | 10.2 | 10.4 | 10.6 | 10.9 | 11.1 | 11.4 | 11.6 | 12.0 | 12.4 | 12.9 | 13.4 | 13.7 |
| 27 | 10.3 | 10.4 | 10.5 | 10.8 | 11.0 | 11.3 | 11.5 | 11.8 | 12.1 | 12.5 | 13.1 | 13.6 | 13.9 |
| 28 | 10.4 | 10.5 | 10.7 | 10.9 | 11.2 | 11.4 | 11.7 | 12.0 | 12.3 | 12.7 | 13.3 | 13.8 | 14.1 |
| 29 | 10.6 | 10.7 | 10.8 | 11.1 | 11.3 | 11.6 | 11.8 | 12.1 | 12.5 | 12.9 | 13.5 | 14.0 | 14.3 |
| 30 | 10.7 | 10.8 | 11.0 | 11.2 | 11.5 | 11.7 | 12.0 | 12.3 | 12.6 | 13.1 | 13.6 | 14.1 | 14.5 |
| 31 | 10.8 | 10.9 | 11.1 | 11.4 | 11.6 | 11.9 | 12.1 | 12.5 | 12.8 | 13.2 | 13.8 | 14.3 | 14.6 |
| 32 | 11.0 | 11.1 | 11.2 | 11.5 | 11.8 | 12.0 | 12.3 | 12.6 | 13.0 | 13.4 | 14.0 | 14.5 | 14.8 |
| 33 | 11.1 | 11.2 | 11.4 | 11.6 | 11.9 | 12.2 | 12.4 | 12.8 | 13.1 | 13.5 | 14.1 | 14.7 | 15.0 |
| 34 | 11.2 | 11.3 | 11.5 | 11.8 | 12.0 | 12.3 | 12.6 | 12.9 | 13.3 | 13.7 | 14.3 | 14.8 | 15.2 |
| 35 | 11.4 | 11.5 | 11.6 | 11.9 | 12.2 | 12.4 | 12.7 | 13.0 | 13.4 | 13.8 | 14.5 | 15.0 | 15.3 |
| 36 | 11.5 | 11.6 | 11.8 | 12.0 | 12.3 | 12.6 | 12.8 | 13.2 | 13.5 | 14.0 | 14.6 | 15.1 | 15.5 |

*Table 3: 3rd, 5th , 10th , 20th , 30th , 40th , 50th , 60th , 70th , 80th , 90th , 95th, 97th centiles for Indian preschoolboys aged 0-36 months for height for age.*

| age | 3rd centile | 5th centile | 10th centile | 20th centile | 30th centile | 40th centile | 50th centile | 60th centile | 70th centil | 80th centil | 90th centil | 95th centil | 97th centil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 47.9 | 48.2 | 48.7 | 49.4 | 49.9 | 50.5 | 51.0 | 51.6 | 52.2 | 53.0 | 54.1 | 55.0 | 55.7 |
| 1 | 50.1 | 50.6 | 51.3 | 52.2 | 53.0 | 53.7 | 54.3 | 55.0 | 55.7 | 56.5 | 57.5 | 58.3 | 58.8 |
| 2 | 54.1 | 54.5 | 55.2 | 56.1 | 56.8 | 57.5 | 58.1 | 58.8 | 59.5 | 60.2 | 61.2 | 61.9 | 62.4 |
| 3 | 57.3 | 57.7 | 58.3 | 59.1 | 59.8 | 60.5 | 61.1 | 61.8 | 62.4 | 63.2 | 64.1 | 64.9 | 65.3 |
| 4 | 59.7 | 60.1 | 60.7 | 61.5 | 62.1 | 62.8 | 63.4 | 64.0 | 64.7 | 65.5 | 66.4 | 67.1 | 67.6 |
| 5 | 61.7 | 62.1 | 62.6 | 63.4 | 64.0 | 64.6 | 65.3 | 65.9 | 66.6 | 67.3 | 68.3 | 69.0 | 69.5 |
| 6 | 63.4 | 63.7 | 64.3 | 65.0 | 65.6 | 66.2 | 66.8 | 67.5 | 68.1 | 68.9 | 69.9 | 70.6 | 71.1 |
| 7 | 64.9 | 65.2 | 65.7 | 66.4 | 67.0 | 67.6 | 68.2 | 68.8 | 69.5 | 70.3 | 71.3 | 72.1 | 72.6 |
| 8 | 66.3 | 66.5 | 67.0 | 67.7 | 68.3 | 68.8 | 69.4 | 70.1 | 70.8 | 71.6 | 72.6 | 73.4 | 73.9 |
| 9 | 67.5 | 67.8 | 68.2 | 68.9 | 69.4 | 70.0 | 70.6 | 71.3 | 72.0 | 72.7 | 73.8 | 74.6 | 75.2 |
| 10 | 68.7 | 68.9 | 69.4 | 70.0 | 70.5 | 71.1 | 71.7 | 72.4 | 73.1 | 73.9 | 75.0 | 75.8 | 76.4 |
| 11 | 69.8 | 70.0 | 70.4 | 71.0 | 71.6 | 72.1 | 72.7 | 73.4 | 74.1 | 74.9 | 76.1 | 77.0 | 77.6 |
| 12 | 70.8 | 71.0 | 71.4 | 72.0 | 72.6 | 73.1 | 73.7 | 74.4 | 75.1 | 76.0 | 77.1 | 78.1 | 78.7 |
| 13 | 71.8 | 72.0 | 72.4 | 73.0 | 73.5 | 74.1 | 74.7 | 75.3 | 76.1 | 76.9 | 78.1 | 79.1 | 79.8 |
| 14 | 72.7 | 72.9 | 73.3 | 73.9 | 74.4 | 75.0 | 75.6 | 76.2 | 77.0 | 77.9 | 79.2 | 80.2 | 80.9 |
| 15 | 73.7 | 73.9 | 74.2 | 74.8 | 75.3 | 75.9 | 76.5 | 77.2 | 77.9 | 78.9 | 80.2 | 81.3 | 82.0 |
| 16 | 74.6 | 74.8 | 75.2 | 75.7 | 76.2 | 76.8 | 77.4 | 78.1 | 78.9 | 79.8 | 81.2 | 82.3 | 83.1 |
| 17 | 75.6 | 75.8 | 76.1 | 76.7 | 77.2 | 77.8 | 78.4 | 79.1 | 79.9 | 80.8 | 82.2 | 83.3 | 84.1 |
| 18 | 76.5 | 76.7 | 77.0 | 77.6 | 78.1 | 78.7 | 79.3 | 80.0 | 80.8 | 81.8 | 83.2 | 84.4 | 85.2 |
| 19 | 77.4 | 77.6 | 77.9 | 78.5 | 79.0 | 79.6 | 80.2 | 80.9 | 81.7 | 82.7 | 84.1 | 85.3 | 86.1 |
| 20 | 78.2 | 78.4 | 78.8 | 79.3 | 79.8 | 80.4 | 81.0 | 81.7 | 82.6 | 83.6 | 85.0 | 86.2 | 87.0 |
| 21 | 79.0 | 79.2 | 79.6 | 80.1 | 80.6 | 81.2 | 81.8 | 82.5 | 83.4 | 84.4 | 85.8 | 87.1 | 87.9 |
| 22 | 79.8 | 80.0 | 80.3 | 80.9 | 81.4 | 82.0 | 82.6 | 83.3 | 84.2 | 85.2 | 86.6 | 87.9 | 88.8 |
| 23 | 80.5 | 80.7 | 81.1 | 81.6 | 82.1 | 82.7 | 83.4 | 84.1 | 84.9 | 86.0 | 87.5 | 88.7 | 89.6 |
| 24 | 81.2 | 81.4 | 81.8 | 82.3 | 82.9 | 83.4 | 84.1 | 84.8 | 85.7 | 86.8 | 88.3 | 89.6 | 90.5 |
| 25 | 81.9 | 82.1 | 82.5 | 83.0 | 83.6 | 84.2 | 84.8 | 85.6 | 86.5 | 87.6 | 89.1 | 90.4 | 91.3 |
| 26 | 82.6 | 82.8 | 83.2 | 83.7 | 84.3 | 84.9 | 85.6 | 86.3 | 87.2 | 88.4 | 89.9 | 91.3 | 92.2 |
| 27 | 83.3 | 83.5 | 83.9 | 84.4 | 85.0 | 85.6 | 86.3 | 87.1 | 88.0 | 89.1 | 90.8 | 92.1 | 93.0 |
| 28 | 84.0 | 84.2 | 84.5 | 85.1 | 85.7 | 86.3 | 87.0 | 87.8 | 88.8 | 89.9 | 91.6 | 93.0 | 93.9 |
| 29 | 84.7 | 84.9 | 85.2 | 85.8 | 86.4 | 87.0 | 87.7 | 88.6 | 89.5 | 90.7 | 92.4 | 93.8 | 94.7 |
| 30 | 85.3 | 85.5 | 85.9 | 86.5 | 87.0 | 87.7 | 88.4 | 89.3 | 90.3 | 91.5 | 93.2 | 94.6 | 95.5 |
| 31 | 86.0 | 86.1 | 86.5 | 87.1 | 87.7 | 88.4 | 89.1 | 90.0 | 91.0 | 92.2 | 93.9 | 95.4 | 96.3 |
| 32 | 86.6 | 86.8 | 87.1 | 87.7 | 88.4 | 89.0 | 89.8 | 90.7 | 91.7 | 93.0 | 94.7 | 96.1 | 97.1 |
| 33 | 87.2 | 87.4 | 87.7 | 88.4 | 89.0 | 89.7 | 90.5 | 91.4 | 92.4 | 93.7 | 95.4 | 96.9 | 97.9 |
| 34 | 87.8 | 88.0 | 88.3 | 89.0 | 89.6 | 90.3 | 91.1 | 92.0 | 93.1 | 94.4 | 96.2 | 97.7 | 98.6 |
| 35 | 88.4 | 88.6 | 88.9 | 89.6 | 90.2 | 91.0 | 91.8 | 92.7 | 93.8 | 95.1 | 96.9 | 98.4 | 99.4 |
| 36 | 89.0 | 89.1 | 89.5 | 90.2 | 90.8 | 91.6 | 92.4 | 93.3 | 94.5 | 95.8 | 97.6 | 99.1 | 100.1 |

*Table 4: 3rd, 5th , 10th , 20th , 30th , 40th , 50th , 60th , 70th , 80th , 90th , 95th, 97th centiles for Indian preschool boys (height in range 48cm-103cm) data for weight for height.*

| ht(in cm) | 3rd centile | 5th centile | 10th centile | 20th centile | 30th centile | 40th centile | 50th centile | 60th centile | 70th centil | 80th centil | 90th centil | 95th centil | 97th centil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.8 | 2.9 | 3.1 | 3.2 | 3.3 | 3.4 |
| 48.5 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.9 | 3.0 | 3.2 | 3.3 | 3.5 | 3.5 |
| 49 | 2.6 | 2.6 | 2.6 | 2.7 | 2.8 | 2.8 | 2.9 | 3.0 | 3.1 | 3.3 | 3.5 | 3.6 | 3.7 |
| 49.5 | 2.7 | 2.7 | 2.7 | 2.8 | 2.9 | 3.0 | 3.0 | 3.1 | 3.3 | 3.4 | 3.6 | 3.7 | 3.8 |
| 50 | 2.8 | 2.8 | 2.8 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.4 | 3.5 | 3.7 | 3.8 | 3.9 |
| 50.5 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.8 | 3.9 | 4.0 |
| 51 | 3.0 | 3.0 | 3.1 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.9 | 4.1 | 4.1 |
| 51.5 | 3.1 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.9 | 4.1 | 4.2 | 4.3 |
| 52 | 3.2 | 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 4.0 | 4.2 | 4.3 | 4.4 |
| 52.5 | 3.3 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.1 | 4.3 | 4.4 | 4.5 |
| 53 | 3.4 | 3.4 | 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 3.9 | 4.1 | 4.2 | 4.4 | 4.6 | 4.6 |
| 53.5 | 3.5 | 3.6 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.1 | 4.2 | 4.4 | 4.6 | 4.7 | 4.8 |
| 54 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.5 | 4.7 | 4.8 | 4.9 |
| 54.5 | 3.8 | 3.8 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.6 | 4.8 | 5.0 | 5.0 |
| 55 | 3.9 | 3.9 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.6 | 4.7 | 5.0 | 5.1 | 5.2 |
| 55.5 | 4.0 | 4.0 | 4.1 | 4.1 | 4.2 | 4.3 | 4.4 | 4.6 | 4.7 | 4.9 | 5.1 | 5.2 | 5.3 |
| 56 | 4.1 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.9 | 5.0 | 5.2 | 5.4 | 5.5 |
| 56.5 | 4.2 | 4.3 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 5.0 | 5.2 | 5.4 | 5.5 | 5.6 |
| 57 | 4.4 | 4.4 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 5.0 | 5.1 | 5.3 | 5.5 | 5.7 | 5.8 |
| 57.5 | 4.5 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.3 | 5.5 | 5.7 | 5.8 | 5.9 |
| 58 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.3 | 5.4 | 5.6 | 5.8 | 6.0 | 6.1 |
| 58.5 | 4.8 | 4.8 | 4.8 | 4.9 | 5.0 | 5.1 | 5.3 | 5.4 | 5.6 | 5.7 | 6.0 | 6.1 | 6.2 |
| 59 | 4.9 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.7 | 5.9 | 6.1 | 6.3 | 6.4 |
| 59.5 | 5.0 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.7 | 5.9 | 6.0 | 6.3 | 6.4 | 6.5 |
| 60 | 5.1 | 5.2 | 5.2 | 5.3 | 5.4 | 5.6 | 5.7 | 5.8 | 6.0 | 6.2 | 6.4 | 6.6 | 6.7 |
| 60.5 | 5.3 | 5.3 | 5.4 | 5.5 | 5.6 | 5.7 | 5.8 | 6.0 | 6.1 | 6.3 | 6.6 | 6.7 | 6.8 |
| 61 | 5.4 | 5.4 | 5.5 | 5.6 | 5.7 | 5.8 | 6.0 | 6.1 | 6.3 | 6.5 | 6.7 | 6.9 | 7.0 |
| 61.5 | 5.5 | 5.6 | 5.6 | 5.7 | 5.8 | 6.0 | 6.1 | 6.2 | 6.4 | 6.6 | 6.9 | 7.0 | 7.1 |
| 62 | 5.6 | 5.7 | 5.7 | 5.8 | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.7 | 7.0 | 7.2 | 7.3 |
| 62.5 | 5.7 | 5.8 | 5.8 | 6.0 | 6.1 | 6.2 | 6.3 | 6.5 | 6.7 | 6.9 | 7.1 | 7.3 | 7.4 |
| 63 | 5.9 | 5.9 | 6.0 | 6.1 | 6.2 | 6.3 | 6.5 | 6.6 | 6.8 | 7.0 | 7.3 | 7.4 | 7.5 |
| 63.5 | 6.0 | 6.0 | 6.1 | 6.2 | 6.3 | 6.4 | 6.6 | 6.7 | 6.9 | 7.1 | 7.4 | 7.6 | 7.7 |
| 64 | 6.1 | 6.1 | 6.2 | 6.3 | 6.4 | 6.5 | 6.7 | 6.9 | 7.0 | 7.2 | 7.5 | 7.7 | 7.8 |
| 64.5 | 6.2 | 6.2 | 6.3 | 6.4 | 6.5 | 6.7 | 6.8 | 7.0 | 7.1 | 7.4 | 7.6 | 7.8 | 7.9 |
| 65 | 6.3 | 6.3 | 6.4 | 6.5 | 6.6 | 6.8 | 6.9 | 7.1 | 7.3 | 7.5 | 7.7 | 7.9 | 8.1 |
| 65.5 | 6.4 | 6.4 | 6.5 | 6.6 | 6.7 | 6.9 | 7.0 | 7.2 | 7.4 | 7.6 | 7.9 | 8.1 | 8.2 |
| 66 | 6.5 | 6.5 | 6.6 | 6.7 | 6.8 | 7.0 | 7.1 | 7.3 | 7.5 | 7.7 | 8.0 | 8.2 | 8.3 |
| 66.5 | 6.6 | 6.6 | 6.7 | 6.8 | 6.9 | 7.1 | 7.2 | 7.4 | 7.6 | 7.8 | 8.1 | 8.3 | 8.5 |
| 67 | 6.7 | 6.7 | 6.8 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | 7.7 | 7.9 | 8.2 | 8.4 | 8.6 |
| 67.5 | 6.8 | 6.8 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | 7.6 | 7.8 | 8.1 | 8.4 | 8.6 | 8.7 |
| 68 | 6.9 | 6.9 | 7.0 | 7.1 | 7.3 | 7.4 | 7.6 | 7.7 | 7.9 | 8.2 | 8.5 | 8.7 | 8.8 |
| 68.5 | 7.0 | 7.0 | 7.1 | 7.2 | 7.4 | 7.5 | 7.7 | 7.9 | 8.1 | 8.3 | 8.6 | 8.8 | 9.0 |
| 69 | 7.1 | 7.1 | 7.2 | 7.3 | 7.5 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.7 | 9.0 | 9.1 |
| 69.5 | 7.2 | 7.2 | 7.3 | 7.4 | 7.6 | 7.7 | 7.9 | 8.1 | 8.3 | 8.5 | 8.9 | 9.1 | 9.2 |
| 70 | 7.3 | 7.3 | 7.4 | 7.5 | 7.7 | 7.8 | 8.0 | 8.2 | 8.4 | 8.7 | 9.0 | 9.2 | 9.4 |
| 70.5 | 7.4 | 7.4 | 7.5 | 7.7 | 7.8 | 8.0 | 8.1 | 8.3 | 8.5 | 8.8 | 9.1 | 9.4 | 9.5 |
| 71 | 7.5 | 7.5 | 7.6 | 7.8 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.9 | 9.2 | 9.5 | 9.7 |
| 71.5 | 7.6 | 7.6 | 7.7 | 7.9 | 8.0 | 8.2 | 8.4 | 8.5 | 8.8 | 9.0 | 9.4 | 9.6 | 9.8 |
| 72 | 7.7 | 7.7 | 7.8 | 8.0 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.5 | 9.8 | 9.9 |
| 72.5 | 7.8 | 7.8 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.8 | 9.0 | 9.3 | 9.6 | 9.9 | 10.1 |
| 73 | 7.9 | 7.9 | 8.0 | 8.2 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.4 | 9.7 | 10.0 | 10.2 |
| 73.5 | 8.0 | 8.0 | 8.1 | 8.3 | 8.4 | 8.6 | 8.8 | 9.0 | 9.2 | 9.5 | 9.8 | 10.1 | 10.3 |
| 74 | 8.0 | 8.1 | 8.2 | 8.4 | 8.5 | 8.7 | 8.9 | 9.1 | 9.3 | 9.6 | 10.0 | 10.3 | 10.4 |
| 74.5 | 8.1 | 8.2 | 8.3 | 8.5 | 8.6 | 8.8 | 9.0 | 9.2 | 9.4 | 9.7 | 10.1 | 10.4 | 10.6 |
| 75 | 8.2 | 8.3 | 8.4 | 8.6 | 8.7 | 8.9 | 9.1 | 9.3 | 9.5 | 9.8 | 10.2 | 10.5 | 10.7 |
| 75.5 | 8.3 | 8.4 | 8.5 | 8.7 | 8.8 | 9.0 | 9.2 | 9.4 | 9.7 | 9.9 | 10.3 | 10.6 | 10.8 |
| 76 | 8.4 | 8.5 | 8.6 | 8.8 | 8.9 | 9.1 | 9.3 | 9.5 | 9.8 | 10.0 | 10.4 | 10.7 | 10.9 |
| 76.5 | 8.5 | 8.6 | 8.7 | 8.9 | 9.0 | 9.2 | 9.4 | 9.6 | 9.9 | 10.1 | 10.5 | 10.8 | 11.0 |
| 77 | 8.6 | 8.7 | 8.8 | 9.0 | 9.1 | 9.3 | 9.5 | 9.7 | 10.0 | 10.2 | 10.6 | 10.9 | 11.1 |
| 77.5 | 8.7 | 8.8 | 8.9 | 9.1 | 9.2 | 9.4 | 9.6 | 9.8 | 10.1 | 10.3 | 10.7 | 11.0 | 11.3 |
| 78 | 8.8 | 8.8 | 9.0 | 9.2 | 9.3 | 9.5 | 9.7 | 9.9 | 10.2 | 10.4 | 10.8 | 11.1 | 11.4 |
| 78.5 | 8.9 | 8.9 | 9.1 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.3 | 10.5 | 10.9 | 11.3 | 11.5 |
| 79 | 8.9 | 9.0 | 9.1 | 9.3 | 9.5 | 9.7 | 9.9 | 10.1 | 10.4 | 10.6 | 11.0 | 11.4 | 11.6 |
| 79.5 | 9.0 | 9.1 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.7 | 11.1 | 11.5 | 11.7 |
| 80 | 9.1 | 9.2 | 9.3 | 9.5 | 9.7 | 9.9 | 10.1 | 10.3 | 10.5 | 10.8 | 11.2 | 11.6 | 11.8 |
| 80.5 | 9.2 | 9.3 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.9 | 11.3 | 11.7 | 11.9 |
| 81 | 9.3 | 9.4 | 9.5 | 9.7 | 9.9 | 10.1 | 10.3 | 10.5 | 10.7 | 11.0 | 11.4 | 11.8 | 12.0 |
| 81.5 | 9.4 | 9.5 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.8 | 11.1 | 11.5 | 11.9 | 12.1 |
| 82 | 9.5 | 9.6 | 9.7 | 9.9 | 10.1 | 10.3 | 10.5 | 10.7 | 11.0 | 11.2 | 11.7 | 12.0 | 12.2 |
| 82.5 | 9.6 | 9.7 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.8 | 11.1 | 11.4 | 11.8 | 12.1 | 12.3 |
| 83 | 9.7 | 9.8 | 9.9 | 10.1 | 10.3 | 10.5 | 10.7 | 10.9 | 11.2 | 11.5 | 11.9 | 12.2 | 12.4 |
| 83.5 | 9.8 | 9.9 | 10.0 | 10.2 | 10.4 | 10.6 | 10.8 | 11.0 | 11.3 | 11.6 | 12.0 | 12.3 | 12.6 |
| 84 | 9.9 | 10.0 | 10.1 | 10.3 | 10.5 | 10.7 | 10.9 | 11.1 | 11.4 | 11.7 | 12.1 | 12.4 | 12.7 |
| 84.5 | 10.0 | 10.1 | 10.2 | 10.4 | 10.6 | 10.8 | 11.0 | 11.3 | 11.5 | 11.8 | 12.2 | 12.6 | 12.8 |
| 85 | 10.1 | 10.2 | 10.3 | 10.6 | 10.7 | 10.9 | 11.2 | 11.4 | 11.6 | 11.9 | 12.3 | 12.7 | 12.9 |
| 85.5 | 10.2 | 10.3 | 10.5 | 10.7 | 10.9 | 11.1 | 11.3 | 11.5 | 11.8 | 12.1 | 12.5 | 12.8 | 13.0 |
| 86 | 10.3 | 10.4 | 10.6 | 10.8 | 11.0 | 11.2 | 11.4 | 11.6 | 11.9 | 12.2 | 12.6 | 12.9 | 13.2 |
| 86.5 | 10.5 | 10.5 | 10.7 | 10.9 | 11.1 | 11.3 | 11.5 | 11.7 | 12.0 | 12.3 | 12.7 | 13.1 | 13.3 |
| 87 | 10.6 | 10.6 | 10.8 | 11.0 | 11.2 | 11.4 | 11.6 | 11.9 | 12.1 | 12.4 | 12.8 | 13.2 | 13.4 |
| 87.5 | 10.7 | 10.8 | 10.9 | 11.1 | 11.3 | 11.5 | 11.7 | 12.0 | 12.2 | 12.5 | 13.0 | 13.3 | 13.5 |
| 88 | 10.8 | 10.9 | 11.0 | 11.2 | 11.4 | 11.6 | 11.9 | 12.1 | 12.4 | 12.7 | 13.1 | 13.4 | 13.7 |
| 88.5 | 10.9 | 11.0 | 11.1 | 11.4 | 11.6 | 11.8 | 12.0 | 12.2 | 12.5 | 12.8 | 13.2 | 13.6 | 13.8 |
| 89 | 11.0 | 11.1 | 11.3 | 11.5 | 11.7 | 11.9 | 12.1 | 12.3 | 12.6 | 12.9 | 13.3 | 13.7 | 13.9 |
| 89.5 | 11.1 | 11.2 | 11.4 | 11.6 | 11.8 | 12.0 | 12.2 | 12.5 | 12.7 | 13.0 | 13.5 | 13.8 | 14.0 |
| 90 | 11.2 | 11.3 | 11.5 | 11.7 | 11.9 | 12.1 | 12.3 | 12.6 | 12.8 | 13.2 | 13.6 | 13.9 | 14.2 |
| 90.5 | 11.3 | 11.4 | 11.6 | 11.8 | 12.0 | 12.2 | 12.5 | 12.7 | 13.0 | 13.3 | 13.7 | 14.1 | 14.3 |
| 91 | 11.4 | 11.5 | 11.7 | 11.9 | 12.1 | 12.3 | 12.6 | 12.8 | 13.1 | 13.4 | 13.8 | 14.2 | 14.4 |
| 91.5 | 11.5 | 11.6 | 11.8 | 12.0 | 12.2 | 12.5 | 12.7 | 12.9 | 13.2 | 13.5 | 13.9 | 14.3 | 14.5 |
| 92 | 11.7 | 11.7 | 11.9 | 12.1 | 12.4 | 12.6 | 12.8 | 13.0 | 13.3 | 13.6 | 14.1 | 14.4 | 14.7 |
| 92.5 | 11.8 | 11.8 | 12.0 | 12.2 | 12.5 | 12.7 | 12.9 | 13.1 | 13.4 | 13.7 | 14.2 | 14.5 | 14.8 |
| 93 | 11.9 | 12.0 | 12.1 | 12.4 | 12.6 | 12.8 | 13.0 | 13.3 | 13.5 | 13.9 | 14.3 | 14.7 | 14.9 |
| 93.5 | 12.0 | 12.1 | 12.2 | 12.5 | 12.7 | 12.9 | 13.1 | 13.4 | 13.6 | 14.0 | 14.4 | 14.8 | 15.0 |
| 94 | 12.1 | 12.2 | 12.3 | 12.6 | 12.8 | 13.0 | 13.2 | 13.5 | 13.8 | 14.1 | 14.5 | 14.9 | 15.1 |
| 94.5 | 12.2 | 12.3 | 12.4 | 12.7 | 12.9 | 13.1 | 13.3 | 13.6 | 13.9 | 14.2 | 14.7 | 15.0 | 15.3 |
| 95 | 12.3 | 12.4 | 12.5 | 12.8 | 13.0 | 13.2 | 13.5 | 13.7 | 14.0 | 14.3 | 14.8 | 15.2 | 15.4 |
| 95.5 | 12.4 | 12.5 | 12.6 | 12.9 | 13.1 | 13.3 | 13.6 | 13.8 | 14.1 | 14.4 | 14.9 | 15.3 | 15.5 |
| 96 | 12.5 | 12.6 | 12.7 | 13.0 | 13.2 | 13.4 | 13.7 | 13.9 | 14.2 | 14.6 | 15.0 | 15.4 | 15.7 |
| 96.5 | 12.6 | 12.7 | 12.8 | 13.1 | 13.3 | 13.6 | 13.8 | 14.1 | 14.3 | 14.7 | 15.2 | 15.5 | 15.8 |
| 97 | 12.7 | 12.8 | 13.0 | 13.2 | 13.4 | 13.7 | 13.9 | 14.2 | 14.5 | 14.8 | 15.3 | 15.7 | 15.9 |
| 97.5 | 12.8 | 12.9 | 13.1 | 13.3 | 13.6 | 13.8 | 14.0 | 14.3 | 14.6 | 14.9 | 15.4 | 15.8 | 16.1 |
| 98 | 12.9 | 13.0 | 13.2 | 13.4 | 13.7 | 13.9 | 14.1 | 14.4 | 14.7 | 15.1 | 15.5 | 15.9 | 16.2 |
| 98.5 | 13.0 | 13.1 | 13.3 | 13.5 | 13.8 | 14.0 | 14.3 | 14.5 | 14.8 | 15.2 | 15.7 | 16.1 | 16.3 |
| 99 | 13.1 | 13.2 | 13.4 | 13.7 | 13.9 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.8 | 16.2 | 16.5 |
| 99.5 | 13.2 | 13.3 | 13.5 | 13.8 | 14.0 | 14.2 | 14.5 | 14.8 | 15.1 | 15.4 | 15.9 | 16.3 | 16.6 |
| 100 | 13.3 | 13.4 | 13.6 | 13.9 | 14.1 | 14.4 | 14.6 | 14.9 | 15.2 | 15.6 | 16.1 | 16.5 | 16.8 |
| 100.5 | 13.4 | 13.5 | 13.7 | 14.0 | 14.2 | 14.5 | 14.7 | 15.0 | 15.3 | 15.7 | 16.2 | 16.6 | 16.9 |
| 101 | 13.5 | 13.6 | 13.8 | 14.1 | 14.3 | 14.6 | 14.9 | 15.1 | 15.4 | 15.8 | 16.3 | 16.7 | 17.0 |
| 101.5 | 13.6 | 13.7 | 13.9 | 14.2 | 14.5 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.4 | 16.9 | 17.2 |
| 102 | 13.7 | 13.8 | 14.0 | 14.3 | 14.6 | 14.8 | 15.1 | 15.4 | 15.7 | 16.1 | 16.6 | 17.0 | 17.3 |
| 102.5 | 13.8 | 13.9 | 14.1 | 14.4 | 14.7 | 14.9 | 15.2 | 15.5 | 15.8 | 16.2 | 16.7 | 17.1 | 17.4 |
| 103 | 13.9 | 14.0 | 14.2 | 14.5 | 14.8 | 15.0 | 15.3 | 15.6 | 15.9 | 16.3 | 16.8 | 17.3 | 17.6 |

*Table 5: 3rd, 5th , 10th , 20th , 30th , 40th , 50th , 60th , 70th , 80th , 90th , 95th, 97th centiles for Indian preschool girls aged 0-36 months data for weight for age.*

| age | 3rd centile | 5th centile | 10th centile | 20th centile | 30th centile | 40th centile | 50th centile | 60th centile | 70th centil | 80th centil | 90th centil | 95th centil | 97th centil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.5 | 2.6 | 2.8 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.6 | 3.7 | 4.0 | 4.2 | 4.4 |
| 1 | 2.9 | 3.0 | 3.2 | 3.4 | 3.6 | 3.7 | 3.9 | 4.1 | 4.3 | 4.5 | 4.8 | 5.0 | 5.1 |
| 2 | 3.8 | 3.9 | 4.1 | 4.3 | 4.5 | 4.6 | 4.8 | 5.0 | 5.2 | 5.4 | 5.7 | 5.9 | 6.1 |
| 3 | 4.5 | 4.6 | 4.7 | 4.9 | 5.1 | 5.3 | 5.4 | 5.6 | 5.8 | 6.0 | 6.4 | 6.6 | 6.8 |
| 4 | 5.0 | 5.1 | 5.3 | 5.4 | 5.6 | 5.8 | 5.9 | 6.1 | 6.3 | 6.6 | 6.9 | 7.1 | 7.3 |
| 5 | 5.5 | 5.5 | 5.7 | 5.9 | 6.0 | 6.2 | 6.4 | 6.5 | 6.7 | 7.0 | 7.3 | 7.6 | 7.8 |
| 6 | 5.8 | 5.9 | 6.0 | 6.2 | 6.4 | 6.5 | 6.7 | 6.9 | 7.1 | 7.4 | 7.7 | 8.0 | 8.2 |
| 7 | 6.1 | 6.2 | 6.3 | 6.5 | 6.7 | 6.8 | 7.0 | 7.2 | 7.4 | 7.7 | 8.1 | 8.4 | 8.6 |
| 8 | 6.4 | 6.4 | 6.6 | 6.8 | 6.9 | 7.1 | 7.3 | 7.5 | 7.7 | 8.0 | 8.4 | 8.7 | 8.9 |
| 9 | 6.6 | 6.7 | 6.8 | 7.0 | 7.2 | 7.3 | 7.5 | 7.7 | 8.0 | 8.3 | 8.6 | 9.0 | 9.2 |
| 10 | 6.8 | 6.9 | 7.0 | 7.2 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.5 | 8.9 | 9.2 | 9.5 |
| 11 | 7.0 | 7.1 | 7.2 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.7 | 9.1 | 9.5 | 9.7 |
| 12 | 7.2 | 7.3 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.7 | 9.0 | 9.4 | 9.7 | 10.0 |
| 13 | 7.4 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.9 | 9.2 | 9.6 | 10.0 | 10.2 |
| 14 | 7.5 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.8 | 9.1 | 9.4 | 9.8 | 10.2 | 10.5 |
| 15 | 7.7 | 7.8 | 7.9 | 8.1 | 8.3 | 8.5 | 8.8 | 9.0 | 9.3 | 9.6 | 10.0 | 10.4 | 10.7 |
| 16 | 7.9 | 8.0 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.2 | 9.5 | 9.8 | 10.3 | 10.7 | 10.9 |
| 17 | 8.0 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.4 | 9.7 | 10.0 | 10.5 | 10.9 | 11.2 |
| 18 | 8.2 | 8.3 | 8.4 | 8.7 | 8.9 | 9.1 | 9.3 | 9.6 | 9.9 | 10.2 | 10.7 | 11.1 | 11.4 |
| 19 | 8.4 | 8.5 | 8.6 | 8.8 | 9.1 | 9.3 | 9.5 | 9.8 | 10.1 | 10.4 | 10.9 | 11.4 | 11.7 |
| 20 | 8.5 | 8.6 | 8.8 | 9.0 | 9.2 | 9.4 | 9.7 | 10.0 | 10.3 | 10.6 | 11.2 | 11.6 | 11.9 |
| 21 | 8.7 | 8.8 | 8.9 | 9.2 | 9.4 | 9.6 | 9.9 | 10.1 | 10.5 | 10.8 | 11.4 | 11.8 | 12.1 |
| 22 | 8.9 | 9.0 | 9.1 | 9.4 | 9.6 | 9.8 | 10.0 | 10.3 | 10.6 | 11.0 | 11.6 | 12.0 | 12.4 |
| 23 | 9.0 | 9.1 | 9.3 | 9.5 | 9.7 | 10.0 | 10.2 | 10.5 | 10.8 | 11.2 | 11.8 | 12.3 | 12.6 |
| 24 | 9.2 | 9.3 | 9.4 | 9.7 | 9.9 | 10.1 | 10.4 | 10.7 | 11.0 | 11.4 | 12.0 | 12.5 | 12.8 |
| 25 | 9.4 | 9.4 | 9.6 | 9.8 | 10.1 | 10.3 | 10.6 | 10.9 | 11.2 | 11.6 | 12.2 | 12.7 | 13.0 |
| 26 | 9.5 | 9.6 | 9.8 | 10.0 | 10.2 | 10.5 | 10.7 | 11.0 | 11.4 | 11.8 | 12.4 | 12.9 | 13.3 |
| 27 | 9.7 | 9.8 | 9.9 | 10.2 | 10.4 | 10.6 | 10.9 | 11.2 | 11.5 | 12.0 | 12.6 | 13.1 | 13.5 |
| 28 | 9.8 | 9.9 | 10.1 | 10.3 | 10.6 | 10.8 | 11.1 | 11.4 | 11.7 | 12.1 | 12.7 | 13.3 | 13.7 |
| 29 | 10.0 | 10.1 | 10.2 | 10.5 | 10.7 | 11.0 | 11.2 | 11.5 | 11.9 | 12.3 | 12.9 | 13.5 | 13.9 |
| 30 | 10.1 | 10.2 | 10.4 | 10.6 | 10.9 | 11.1 | 11.4 | 11.7 | 12.0 | 12.5 | 13.1 | 13.7 | 14.1 |
| 31 | 10.3 | 10.4 | 10.5 | 10.8 | 11.0 | 11.3 | 11.5 | 11.8 | 12.2 | 12.6 | 13.3 | 13.9 | 14.2 |
| 32 | 10.4 | 10.5 | 10.7 | 10.9 | 11.2 | 11.4 | 11.7 | 12.0 | 12.4 | 12.8 | 13.5 | 14.0 | 14.4 |
| 33 | 10.6 | 10.7 | 10.8 | 11.1 | 11.3 | 11.6 | 11.8 | 12.1 | 12.5 | 13.0 | 13.6 | 14.2 | 14.6 |
| 34 | 10.7 | 10.8 | 11.0 | 11.2 | 11.4 | 11.7 | 12.0 | 12.3 | 12.7 | 13.1 | 13.8 | 14.4 | 14.8 |
| 35 | 10.8 | 10.9 | 11.1 | 11.3 | 11.6 | 11.8 | 12.1 | 12.4 | 12.8 | 13.3 | 14.0 | 14.6 | 15.0 |
| 36 | 11.0 | 11.1 | 11.2 | 11.5 | 11.7 | 12.0 | 12.3 | 12.6 | 13.0 | 13.4 | 14.1 | 14.7 | 15.2 |

*Table 6: 3rd, 5th , 10th , 20th , 30th , 40th , 50th , 60th , 70th , 80th , 90th , 95th, 97th centiles for Indian preschool girls aged 0-36 months for height for age.*

| age | 3rd centile | 5th centile | 10th centile | 20th centile | 30th centile | 40th centile | 50th centile | 60th centile | 70th centil | 80th centil | 90th centil | 95th centil | 97th centil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 45.3 | 46.4 | 47.8 | 49.2 | 50.0 | 50.5 | 51.0 | 51.5 | 52.0 | 52.7 | 53.7 | 54.6 | 55.3 |
| 1 | 48.6 | 49.1 | 50.0 | 51.1 | 51.9 | 52.6 | 53.3 | 54.0 | 54.6 | 55.4 | 56.4 | 57.1 | 57.6 |
| 2 | 52.7 | 53.1 | 53.8 | 54.8 | 55.6 | 56.3 | 56.9 | 57.6 | 58.3 | 59.1 | 60.1 | 60.8 | 61.3 |
| 3 | 55.5 | 55.9 | 56.5 | 57.4 | 58.1 | 58.8 | 59.5 | 60.1 | 60.8 | 61.6 | 62.6 | 63.4 | 63.9 |
| 4 | 57.8 | 58.1 | 58.7 | 59.5 | 60.2 | 60.8 | 61.5 | 62.2 | 62.9 | 63.7 | 64.7 | 65.5 | 66.0 |
| 5 | 59.7 | 60.0 | 60.6 | 61.4 | 62.0 | 62.7 | 63.3 | 64.0 | 64.7 | 65.5 | 66.5 | 67.3 | 67.8 |
| 6 | 61.5 | 61.8 | 62.3 | 63.0 | 63.7 | 64.3 | 65.0 | 65.6 | 66.4 | 67.2 | 68.2 | 69.0 | 69.6 |
| 7 | 63.0 | 63.3 | 63.8 | 64.5 | 65.1 | 65.8 | 66.4 | 67.1 | 67.8 | 68.7 | 69.8 | 70.6 | 71.1 |
| 8 | 64.4 | 64.7 | 65.1 | 65.8 | 66.4 | 67.1 | 67.7 | 68.4 | 69.2 | 70.0 | 71.1 | 71.9 | 72.5 |
| 9 | 65.6 | 65.9 | 66.3 | 67.0 | 67.6 | 68.2 | 68.9 | 69.6 | 70.3 | 71.2 | 72.3 | 73.2 | 73.7 |
| 10 | 66.7 | 67.0 | 67.4 | 68.1 | 68.7 | 69.3 | 69.9 | 70.6 | 71.4 | 72.3 | 73.4 | 74.3 | 74.9 |
| 11 | 67.8 | 68.0 | 68.4 | 69.1 | 69.7 | 70.3 | 70.9 | 71.6 | 72.4 | 73.3 | 74.5 | 75.4 | 76.0 |
| 12 | 68.7 | 69.0 | 69.4 | 70.0 | 70.6 | 71.2 | 71.9 | 72.6 | 73.4 | 74.3 | 75.5 | 76.4 | 77.0 |
| 13 | 69.7 | 69.9 | 70.3 | 71.0 | 71.5 | 72.2 | 72.8 | 73.5 | 74.3 | 75.3 | 76.5 | 77.5 | 78.1 |
| 14 | 70.7 | 70.9 | 71.3 | 71.9 | 72.5 | 73.1 | 73.8 | 74.5 | 75.3 | 76.3 | 77.5 | 78.5 | 79.2 |
| 15 | 71.7 | 71.9 | 72.3 | 72.9 | 73.5 | 74.1 | 74.8 | 75.5 | 76.3 | 77.3 | 78.6 | 79.6 | 80.3 |
| 16 | 72.7 | 72.9 | 73.3 | 73.9 | 74.5 | 75.1 | 75.8 | 76.5 | 77.3 | 78.3 | 79.7 | 80.7 | 81.4 |
| 17 | 73.7 | 73.9 | 74.2 | 74.9 | 75.4 | 76.1 | 76.7 | 77.5 | 78.4 | 79.4 | 80.7 | 81.8 | 82.5 |
| 18 | 74.6 | 74.8 | 75.2 | 75.8 | 76.4 | 77.0 | 77.7 | 78.5 | 79.3 | 80.3 | 81.7 | 82.8 | 83.6 |
| 19 | 75.5 | 75.7 | 76.1 | 76.7 | 77.3 | 77.9 | 78.6 | 79.4 | 80.3 | 81.3 | 82.7 | 83.9 | 84.6 |
| 20 | 76.4 | 76.6 | 77.0 | 77.6 | 78.2 | 78.8 | 79.5 | 80.3 | 81.2 | 82.2 | 83.7 | 84.8 | 85.6 |
| 21 | 77.2 | 77.4 | 77.8 | 78.4 | 79.0 | 79.6 | 80.4 | 81.1 | 82.0 | 83.1 | 84.6 | 85.8 | 86.6 |
| 22 | 78.0 | 78.2 | 78.6 | 79.2 | 79.8 | 80.5 | 81.2 | 82.0 | 82.9 | 84.0 | 85.5 | 86.7 | 87.5 |
| 23 | 78.8 | 79.0 | 79.4 | 80.0 | 80.6 | 81.3 | 82.0 | 82.8 | 83.7 | 84.8 | 86.4 | 87.6 | 88.5 |
| 24 | 79.6 | 79.8 | 80.2 | 80.8 | 81.4 | 82.0 | 82.8 | 83.6 | 84.5 | 85.7 | 87.2 | 88.5 | 89.4 |
| 25 | 80.4 | 80.6 | 80.9 | 81.5 | 82.1 | 82.8 | 83.5 | 84.4 | 85.3 | 86.5 | 88.1 | 89.4 | 90.3 |
| 26 | 81.1 | 81.3 | 81.7 | 82.3 | 82.9 | 83.5 | 84.3 | 85.1 | 86.1 | 87.2 | 88.9 | 90.2 | 91.1 |
| 27 | 81.8 | 82.0 | 82.4 | 83.0 | 83.6 | 84.2 | 85.0 | 85.8 | 86.8 | 88.0 | 89.7 | 91.1 | 92.0 |
| 28 | 82.5 | 82.7 | 83.1 | 83.7 | 84.3 | 84.9 | 85.7 | 86.6 | 87.5 | 88.8 | 90.5 | 91.9 | 92.8 |
| 29 | 83.2 | 83.4 | 83.7 | 84.3 | 85.0 | 85.6 | 86.4 | 87.3 | 88.3 | 89.5 | 91.2 | 92.7 | 93.6 |
| 30 | 83.9 | 84.0 | 84.4 | 85.0 | 85.6 | 86.3 | 87.1 | 88.0 | 89.0 | 90.2 | 92.0 | 93.5 | 94.5 |
| 31 | 84.5 | 84.7 | 85.1 | 85.7 | 86.3 | 87.0 | 87.8 | 88.7 | 89.7 | 91.0 | 92.8 | 94.3 | 95.3 |
| 32 | 85.2 | 85.4 | 85.7 | 86.4 | 87.0 | 87.7 | 88.5 | 89.3 | 90.4 | 91.7 | 93.5 | 95.0 | 96.1 |
| 33 | 85.8 | 86.0 | 86.4 | 87.0 | 87.6 | 88.3 | 89.1 | 90.0 | 91.1 | 92.4 | 94.2 | 95.8 | 96.9 |
| 34 | 86.5 | 86.7 | 87.1 | 87.7 | 88.3 | 89.0 | 89.8 | 90.7 | 91.8 | 93.1 | 95.0 | 96.6 | 97.7 |
| 35 | 87.1 | 87.3 | 87.7 | 88.3 | 88.9 | 89.6 | 90.4 | 91.4 | 92.4 | 93.8 | 95.7 | 97.3 | 98.5 |
| 36 | 87.8 | 88.0 | 88.3 | 88.9 | 89.6 | 90.3 | 91.1 | 92.0 | 93.1 | 94.5 | 96.4 | 98.1 | 99.2 |

*Table 7 :3rd , 5th , 10th , 20th , 30th , 40th , 50th , 60th , 70th , 80th , 90th , 95th, 97th centiles for Indian preschool girls (height range in 48cm-103cm) for weight for height.*

| ht | 3rd centile | 5th centile | 10th centile | 20th centile | 30th centile | 40th centile | 50th centile | 60th centile | 70th centil | 80th centil | 90th centil | 95th centil | 97th centil |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.3 |
| 48.5 | 2.6 | 2.6 | 2.6 | 2.7 | 2.8 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 |
| 49 | 2.7 | 2.7 | 2.7 | 2.8 | 2.9 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 |
| 49.5 | 2.8 | 2.8 | 2.8 | 2.9 | 3.0 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 |
| 50 | 2.8 | 2.9 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 |
| 50.5 | 2.9 | 3.0 | 3.0 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.8 | 3.9 | 3.9 |
| 51 | 3.0 | 3.1 | 3.1 | 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.9 | 4.0 | 4.1 |
| 51.5 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 4.0 | 4.1 | 4.2 |
| 52 | 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 4.0 | 4.1 | 4.2 | 4.3 |
| 52.5 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 4.0 | 4.1 | 4.2 | 4.4 | 4.5 |
| 53 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.4 | 4.5 | 4.6 |
| 53.5 | 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.5 | 4.6 | 4.7 |
| 54 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.5 | 4.6 | 4.8 | 4.9 |
| 54.5 | 3.8 | 3.8 | 3.9 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.5 | 4.6 | 4.8 | 4.9 | 5.0 |
| 55 | 3.9 | 3.9 | 4.0 | 4.1 | 4.1 | 4.2 | 4.3 | 4.5 | 4.6 | 4.7 | 4.9 | 5.1 | 5.2 |
| 55.5 | 4.0 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.9 | 5.1 | 5.2 | 5.3 |
| 56 | 4.1 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 5.0 | 5.2 | 5.4 | 5.5 |
| 56.5 | 4.2 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 5.0 | 5.1 | 5.3 | 5.5 | 5.6 |
| 57 | 4.3 | 4.4 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 5.0 | 5.1 | 5.3 | 5.5 | 5.7 | 5.8 |
| 57.5 | 4.4 | 4.5 | 4.5 | 4.6 | 4.7 | 4.9 | 5.0 | 5.1 | 5.2 | 5.4 | 5.6 | 5.8 | 5.9 |
| 58 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.4 | 5.5 | 5.8 | 5.9 | 6.1 |
| 58.5 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.5 | 5.7 | 5.9 | 6.1 | 6.2 |
| 59 | 4.8 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.5 | 5.6 | 5.8 | 6.0 | 6.2 | 6.4 |
| 59.5 | 4.9 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.5 | 5.6 | 5.8 | 5.9 | 6.2 | 6.4 | 6.5 |
| 60 | 5.0 | 5.0 | 5.1 | 5.2 | 5.3 | 5.5 | 5.6 | 5.7 | 5.9 | 6.1 | 6.3 | 6.5 | 6.6 |
| 60.5 | 5.1 | 5.1 | 5.2 | 5.3 | 5.4 | 5.6 | 5.7 | 5.8 | 6.0 | 6.2 | 6.4 | 6.7 | 6.8 |
| 61 | 5.2 | 5.2 | 5.3 | 5.4 | 5.6 | 5.7 | 5.8 | 6.0 | 6.1 | 6.3 | 6.6 | 6.8 | 6.9 |
| 61.5 | 5.3 | 5.4 | 5.4 | 5.6 | 5.7 | 5.8 | 5.9 | 6.1 | 6.2 | 6.4 | 6.7 | 6.9 | 7.1 |
| 62 | 5.4 | 5.5 | 5.5 | 5.7 | 5.8 | 5.9 | 6.0 | 6.2 | 6.4 | 6.6 | 6.8 | 7.1 | 7.2 |
| 62.5 | 5.5 | 5.6 | 5.6 | 5.8 | 5.9 | 6.0 | 6.2 | 6.3 | 6.5 | 6.7 | 7.0 | 7.2 | 7.3 |
| 63 | 5.6 | 5.7 | 5.7 | 5.9 | 6.0 | 6.1 | 6.3 | 6.4 | 6.6 | 6.8 | 7.1 | 7.3 | 7.5 |
| 63.5 | 5.7 | 5.8 | 5.8 | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.7 | 6.9 | 7.2 | 7.4 | 7.6 |
| 64 | 5.8 | 5.9 | 5.9 | 6.1 | 6.2 | 6.3 | 6.5 | 6.6 | 6.8 | 7.0 | 7.3 | 7.6 | 7.7 |
| 64.5 | 5.9 | 6.0 | 6.0 | 6.2 | 6.3 | 6.4 | 6.6 | 6.8 | 6.9 | 7.2 | 7.4 | 7.7 | 7.8 |
| 65 | 6.0 | 6.1 | 6.1 | 6.3 | 6.4 | 6.5 | 6.7 | 6.9 | 7.0 | 7.3 | 7.6 | 7.8 | 8.0 |
| 65.5 | 6.1 | 6.2 | 6.2 | 6.4 | 6.5 | 6.7 | 6.8 | 7.0 | 7.2 | 7.4 | 7.7 | 7.9 | 8.1 |
| 66 | 6.2 | 6.3 | 6.3 | 6.5 | 6.6 | 6.8 | 6.9 | 7.1 | 7.3 | 7.5 | 7.8 | 8.1 | 8.2 |
| 66.5 | 6.3 | 6.3 | 6.4 | 6.6 | 6.7 | 6.9 | 7.0 | 7.2 | 7.4 | 7.6 | 7.9 | 8.2 | 8.3 |
| 67 | 6.4 | 6.4 | 6.5 | 6.7 | 6.8 | 7.0 | 7.1 | 7.3 | 7.5 | 7.7 | 8.0 | 8.3 | 8.5 |
| 67.5 | 6.5 | 6.5 | 6.6 | 6.8 | 6.9 | 7.1 | 7.2 | 7.4 | 7.6 | 7.8 | 8.2 | 8.4 | 8.6 |
| 68 | 6.6 | 6.6 | 6.7 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | 7.7 | 8.0 | 8.3 | 8.5 | 8.7 |
| 68.5 | 6.7 | 6.7 | 6.8 | 7.0 | 7.1 | 7.3 | 7.4 | 7.6 | 7.8 | 8.1 | 8.4 | 8.7 | 8.8 |
| 69 | 6.8 | 6.8 | 6.9 | 7.1 | 7.2 | 7.4 | 7.6 | 7.7 | 7.9 | 8.2 | 8.5 | 8.8 | 9.0 |
| 69.5 | 6.9 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | 7.7 | 7.8 | 8.0 | 8.3 | 8.6 | 8.9 | 9.1 |
| 70 | 7.0 | 7.0 | 7.1 | 7.3 | 7.4 | 7.6 | 7.8 | 7.9 | 8.2 | 8.4 | 8.7 | 9.0 | 9.2 |
| 70.5 | 7.1 | 7.1 | 7.2 | 7.4 | 7.5 | 7.7 | 7.9 | 8.1 | 8.3 | 8.5 | 8.8 | 9.1 | 9.3 |
| 71 | 7.2 | 7.2 | 7.3 | 7.5 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 9.0 | 9.2 | 9.4 |
| 71.5 | 7.2 | 7.3 | 7.4 | 7.6 | 7.7 | 7.9 | 8.1 | 8.3 | 8.5 | 8.7 | 9.1 | 9.3 | 9.5 |
| 72 | 7.3 | 7.4 | 7.5 | 7.7 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.8 | 9.2 | 9.5 | 9.6 |
| 72.5 | 7.4 | 7.5 | 7.6 | 7.8 | 7.9 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.3 | 9.6 | 9.8 |
| 73 | 7.5 | 7.6 | 7.7 | 7.9 | 8.0 | 8.2 | 8.4 | 8.6 | 8.8 | 9.0 | 9.4 | 9.7 | 9.9 |
| 73.5 | 7.6 | 7.7 | 7.8 | 8.0 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.5 | 9.8 | 10.0 |
| 74 | 7.7 | 7.8 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.8 | 9.0 | 9.2 | 9.6 | 9.9 | 10.1 |
| 74.5 | 7.8 | 7.8 | 8.0 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | 9.3 | 9.7 | 10.0 | 10.2 |
| 75 | 7.9 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.8 | 9.0 | 9.2 | 9.4 | 9.8 | 10.1 | 10.3 |
| 75.5 | 7.9 | 8.0 | 8.1 | 8.3 | 8.5 | 8.7 | 8.8 | 9.0 | 9.3 | 9.5 | 9.9 | 10.2 | 10.4 |
| 76 | 8.0 | 8.1 | 8.2 | 8.4 | 8.6 | 8.8 | 8.9 | 9.1 | 9.4 | 9.6 | 10.0 | 10.3 | 10.5 |
| 76.5 | 8.1 | 8.2 | 8.3 | 8.5 | 8.7 | 8.9 | 9.0 | 9.2 | 9.5 | 9.7 | 10.1 | 10.4 | 10.6 |
| 77 | 8.2 | 8.3 | 8.4 | 8.6 | 8.8 | 9.0 | 9.1 | 9.3 | 9.6 | 9.8 | 10.2 | 10.5 | 10.7 |
| 77.5 | 8.3 | 8.4 | 8.5 | 8.7 | 8.9 | 9.0 | 9.2 | 9.4 | 9.7 | 9.9 | 10.3 | 10.6 | 10.8 |
| 78 | 8.4 | 8.5 | 8.6 | 8.8 | 9.0 | 9.1 | 9.3 | 9.5 | 9.8 | 10.0 | 10.4 | 10.7 | 10.9 |
| 78.5 | 8.5 | 8.5 | 8.7 | 8.9 | 9.1 | 9.2 | 9.4 | 9.6 | 9.9 | 10.1 | 10.5 | 10.8 | 11.0 |
| 79 | 8.6 | 8.6 | 8.8 | 9.0 | 9.2 | 9.4 | 9.5 | 9.7 | 10.0 | 10.2 | 10.6 | 10.9 | 11.2 |
| 79.5 | 8.7 | 8.7 | 8.9 | 9.1 | 9.3 | 9.5 | 9.6 | 9.9 | 10.1 | 10.4 | 10.7 | 11.1 | 11.3 |
| 80 | 8.8 | 8.8 | 9.0 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.5 | 10.9 | 11.2 | 11.4 |
| 80.5 | 8.8 | 8.9 | 9.1 | 9.3 | 9.5 | 9.7 | 9.9 | 10.1 | 10.3 | 10.6 | 11.0 | 11.3 | 11.5 |
| 81 | 8.9 | 9.0 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.7 | 11.1 | 11.4 | 11.6 |
| 81.5 | 9.0 | 9.1 | 9.3 | 9.5 | 9.7 | 9.9 | 10.1 | 10.3 | 10.5 | 10.8 | 11.2 | 11.5 | 11.8 |
| 82 | 9.1 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.9 | 11.3 | 11.7 | 11.9 |
| 82.5 | 9.3 | 9.3 | 9.5 | 9.7 | 9.9 | 10.1 | 10.3 | 10.5 | 10.8 | 11.0 | 11.4 | 11.8 | 12.0 |
| 83 | 9.4 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.9 | 11.2 | 11.6 | 11.9 | 12.1 |
| 83.5 | 9.5 | 9.5 | 9.7 | 9.9 | 10.1 | 10.3 | 10.5 | 10.7 | 11.0 | 11.3 | 11.7 | 12.0 | 12.3 |
| 84 | 9.6 | 9.7 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.9 | 11.1 | 11.4 | 11.8 | 12.2 | 12.4 |
| 84.5 | 9.7 | 9.8 | 9.9 | 10.1 | 10.3 | 10.5 | 10.8 | 11.0 | 11.2 | 11.5 | 11.9 | 12.3 | 12.5 |
| 85 | 9.8 | 9.9 | 10.0 | 10.3 | 10.5 | 10.7 | 10.9 | 11.1 | 11.3 | 11.6 | 12.1 | 12.4 | 12.6 |
| 85.5 | 9.9 | 10.0 | 10.1 | 10.4 | 10.6 | 10.8 | 11.0 | 11.2 | 11.5 | 11.8 | 12.2 | 12.5 | 12.8 |
| 86 | 10.0 | 10.1 | 10.2 | 10.5 | 10.7 | 10.9 | 11.1 | 11.3 | 11.6 | 11.9 | 12.3 | 12.7 | 12.9 |
| 86.5 | 10.1 | 10.2 | 10.4 | 10.6 | 10.8 | 11.0 | 11.2 | 11.4 | 11.7 | 12.0 | 12.4 | 12.8 | 13.0 |
| 87 | 10.2 | 10.3 | 10.5 | 10.7 | 10.9 | 11.1 | 11.3 | 11.6 | 11.8 | 12.1 | 12.6 | 12.9 | 13.2 |
| 87.5 | 10.3 | 10.4 | 10.6 | 10.8 | 11.0 | 11.2 | 11.4 | 11.7 | 11.9 | 12.3 | 12.7 | 13.1 | 13.3 |
| 88 | 10.4 | 10.5 | 10.7 | 10.9 | 11.1 | 11.3 | 11.6 | 11.8 | 12.1 | 12.4 | 12.8 | 13.2 | 13.5 |
| 88.5 | 10.5 | 10.6 | 10.8 | 11.0 | 11.3 | 11.5 | 11.7 | 11.9 | 12.2 | 12.5 | 13.0 | 13.3 | 13.6 |
| 89 | 10.6 | 10.7 | 10.9 | 11.2 | 11.4 | 11.6 | 11.8 | 12.0 | 12.3 | 12.6 | 13.1 | 13.5 | 13.7 |
| 89.5 | 10.7 | 10.8 | 11.0 | 11.3 | 11.5 | 11.7 | 11.9 | 12.2 | 12.4 | 12.8 | 13.2 | 13.6 | 13.9 |
| 90 | 10.9 | 11.0 | 11.1 | 11.4 | 11.6 | 11.8 | 12.0 | 12.3 | 12.5 | 12.9 | 13.3 | 13.7 | 14.0 |
| 90.5 | 11.0 | 11.1 | 11.2 | 11.5 | 11.7 | 11.9 | 12.1 | 12.4 | 12.7 | 13.0 | 13.5 | 13.9 | 14.1 |
| 91 | 11.1 | 11.2 | 11.3 | 11.6 | 11.8 | 12.0 | 12.3 | 12.5 | 12.8 | 13.1 | 13.6 | 14.0 | 14.3 |
| 91.5 | 11.2 | 11.3 | 11.5 | 11.7 | 11.9 | 12.1 | 12.4 | 12.6 | 12.9 | 13.2 | 13.7 | 14.1 | 14.4 |
| 92 | 11.3 | 11.4 | 11.6 | 11.8 | 12.0 | 12.3 | 12.5 | 12.7 | 13.0 | 13.4 | 13.8 | 14.3 | 14.5 |
| 92.5 | 11.4 | 11.5 | 11.7 | 11.9 | 12.1 | 12.4 | 12.6 | 12.9 | 13.1 | 13.5 | 14.0 | 14.4 | 14.7 |
| 93 | 11.5 | 11.6 | 11.8 | 12.0 | 12.3 | 12.5 | 12.7 | 13.0 | 13.3 | 13.6 | 14.1 | 14.5 | 14.8 |
| 93.5 | 11.6 | 11.7 | 11.9 | 12.1 | 12.4 | 12.6 | 12.8 | 13.1 | 13.4 | 13.7 | 14.2 | 14.7 | 14.9 |
| 94 | 11.7 | 11.8 | 12.0 | 12.3 | 12.5 | 12.7 | 12.9 | 13.2 | 13.5 | 13.8 | 14.3 | 14.8 | 15.1 |
| 94.5 | 11.8 | 11.9 | 12.1 | 12.4 | 12.6 | 12.8 | 13.1 | 13.3 | 13.6 | 14.0 | 14.5 | 14.9 | 15.2 |
| 95 | 11.9 | 12.0 | 12.2 | 12.5 | 12.7 | 12.9 | 13.2 | 13.4 | 13.7 | 14.1 | 14.6 | 15.0 | 15.4 |
| 95.5 | 12.0 | 12.1 | 12.3 | 12.6 | 12.8 | 13.0 | 13.3 | 13.5 | 13.8 | 14.2 | 14.7 | 15.2 | 15.5 |
| 96 | 12.1 | 12.2 | 12.4 | 12.7 | 12.9 | 13.1 | 13.4 | 13.7 | 14.0 | 14.3 | 14.8 | 15.3 | 15.6 |
| 96.5 | 12.2 | 12.4 | 12.5 | 12.8 | 13.0 | 13.3 | 13.5 | 13.8 | 14.1 | 14.4 | 15.0 | 15.4 | 15.8 |
| 97 | 12.4 | 12.5 | 12.6 | 12.9 | 13.1 | 13.4 | 13.6 | 13.9 | 14.2 | 14.6 | 15.1 | 15.6 | 15.9 |
| 97.5 | 12.5 | 12.6 | 12.7 | 13.0 | 13.2 | 13.5 | 13.7 | 14.0 | 14.3 | 14.7 | 15.2 | 15.7 | 16.0 |
| 98 | 12.6 | 12.7 | 12.9 | 13.1 | 13.3 | 13.6 | 13.8 | 14.1 | 14.4 | 14.8 | 15.4 | 15.8 | 16.2 |
| 98.5 | 12.7 | 12.8 | 13.0 | 13.2 | 13.5 | 13.7 | 13.9 | 14.2 | 14.5 | 14.9 | 15.5 | 16.0 | 16.3 |
| 99 | 12.8 | 12.9 | 13.1 | 13.3 | 13.6 | 13.8 | 14.1 | 14.3 | 14.7 | 15.0 | 15.6 | 16.1 | 16.4 |
| 99.5 | 12.9 | 13.0 | 13.2 | 13.4 | 13.7 | 13.9 | 14.2 | 14.5 | 14.8 | 15.2 | 15.7 | 16.2 | 16.6 |
| 100 | 13.0 | 13.1 | 13.3 | 13.6 | 13.8 | 14.0 | 14.3 | 14.6 | 14.9 | 15.3 | 15.9 | 16.4 | 16.7 |
| 100.5 | 13.1 | 13.2 | 13.4 | 13.7 | 13.9 | 14.1 | 14.4 | 14.7 | 15.0 | 15.4 | 16.0 | 16.5 | 16.9 |
| 101 | 13.2 | 13.3 | 13.5 | 13.8 | 14.0 | 14.3 | 14.5 | 14.8 | 15.1 | 15.5 | 16.1 | 16.6 | 17.0 |
| 101.5 | 13.3 | 13.4 | 13.6 | 13.9 | 14.1 | 14.4 | 14.6 | 14.9 | 15.3 | 15.7 | 16.3 | 16.8 | 17.1 |
| 102 | 13.4 | 13.5 | 13.7 | 14.0 | 14.2 | 14.5 | 14.7 | 15.0 | 15.4 | 15.8 | 16.4 | 16.9 | 17.3 |
| 102.5 | 13.6 | 13.7 | 13.8 | 14.1 | 14.3 | 14.6 | 14.9 | 15.2 | 15.5 | 15.9 | 16.5 | 17.0 | 17.4 |
| 103 | 13.7 | 13.8 | 14.0 | 14.2 | 14.5 | 14.7 | 15.0 | 15.3 | 15.6 | 16.0 | 16.6 | 17.2 | 17.6 |

**DISCUSSION**

The basis of the present study is that the WHO CGS 2006 are not more representative of size of children in India, since it might be noted that for the development of the WHO growth standards, WHO used 6669 children (3450 boys and 3219 girls) cross sectional and 882 (428 boys, 454 girls) longitudinal below 5 year old age data and in which only 1487 cross sectional and 174 longitudinal children data were from India, the other participating countries being Brazil, Ghana, Norway, Oman and US. Using the NFHS-3 2006 secondary data from India an attempt is made to construct local growth reference curves for preschool children aged 0-36 months from India and we intend to compare these local growth reference cut offs of malnutrition with WHO CGS 2006. It is been observed that for anthropometric indicators of wt/age, ht/age, wt/ht for Indian preschool children (boys and girls) the upper cut-offs ($97^{th}$ growth reference centile values) are far lower than that of WHO CGS, 2006 upper cut-offs, Which implies that overweight /obesity tallness and disproportionateness are not issues to be worried in Indian context (Figures 1-6). In the present study, for checking the validation of these local growth references for Indian preschool children weight for age, height for age, weight for height anthropometric indicators, which are useful in nutritional assessment studies and to make comparison with that of WHO CGS, 2006 we computed sensitivity and specificity for these growth references, and tested the significance of difference between malnutrition prevalence taking data of children anthropometry NNMB [(19)] (2005-2006).

The NNMB data consisted of 1933, 1931, 1930, 1810, 1806, 1801 anthropometric measurements of wt/age, ht/age and wt/ht of boys and girls respectively. Sensitivity and specificity values and the 2 X 2 contingency table values for local growth reference cut offs in identifying malnutrition in Indian children aged 0-36 months as compared to that of WHO CGS cut offs for wt/age, ht/age and wt/ht are computed (Table 7). The prevalence of underweight, stunted and wasted children aged 0-36 months and Z values and p values for the test of significance of difference between prevalence of malnourished children identified using local growth reference cut offs and WHO CGS 2006 cut offs from NNMB secondary data are also computed (Table 8).

*Table 8 : 2X2 contingencies between WHO CGS and local growth reference in classifying children as malnourished or normal.*

| GAMLSS→ WHO↓ | Wt/age Boys | | Wt/age Girls | | Ht/age Boys | | Ht/age Girls | | Wt/ht Boys | | Wt/ht Girls | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1076 | 39 | 1101 | 55 | 1031 | 9 | 1014 | 2 | 1382 | 45 | 1378 | 45 |
| 1 | 7 | 811 | 3 | 651 | 43 | 848 | 44 | 746 | 19 | 484 | 13 | 365 |
| Sensitivity | 0.99 | | 0.995 | | 0.951 | | 0.944 | | 0.962 | | 0.965 | |
| Specificity | 0.965 | | 0.952 | | 0.991 | | 0.998 | | 0.968 | | 0.968 | |

*Note: 0 = normal ; 1=malnutrition (under weight/stunted/wasted).*

*Table 9: Prevalence of malnourished children from NNMB data obtained using WHO CGS and Local growth reference of Indian boys and girls aged 0-36 months.*

| Growth standard / reference ↓ Sample size → | Under weight Boys 1933 | Under weight Girls 1810 | Stunted Boys 1931 | Stunted Girls 1806 | Wasted Boys 1930 | Wasted Girls 1801 |
|---|---|---|---|---|---|---|
| WHO | 818(42.3%) | 654(36.1%) | 891(46.1%) | 790(43.7%) | 503(26.0%) | 378(21%) |
| GAMLSS(Local) | 850(44%) | 706(39%) | 857(44.3%) | 748(41.4%) | 529(27.4%) | 410(22.8%) |
| Z value | -1.039 | -1.785 | 1.099 | 1.413 | -0.946 | -1.29 |
| P value | 0.2988 | 0.0743 | 0.2718 | 0.1577 | (0.3441) | 0.1971 |

From the above we can infer that the sensitivity and specificity are equally high (range in 0.944, 0.995) using both the local growth reference and WHO, CGS 2006 and there is no significant difference between the prevalence of malnutrition (under weight, stunted and wasted) obtained using local growth reference and WHO, CGS 2006 from NNMB data.

**Conclusion**

The present study is an effort to improve representation of children malnutrition in Indian context by developing new growth reference centiles for wt/age, ht/age and wt/ht of Indian children aged 0-36 months using GAMLSS method. Though the local growth reference data for Indian children aged 0-36 months are not fully satisfying the conditions lay down by WHO to be called a growth standard data, it was observed during our study that there were no statistically significant discrepancies in underweight, stunted and wasted prevalence when using local growth references versus WHO CGS, 2006. Therefore we concluded that the performance and potential impact of the WHO CGS, 2006 need not be evaluated further before their adoption in India. Local growth reference centiles for Indian preschool children wt/age, ht/age and wt/ht anthropometric indices obtained from NFHS- 3 cross- sectional data in the present study can be used as national growth references for children aged 0-36 months as they are derived exclusively from the local growth reference data (Indian preschool children aged 0-36 months). The local growth references are derived in the present study using cross-sectional secondary data with varying sample sizes for different age and height groups (there are age and height groups with size less that 50 also height and length could not be adjusted (under 2 years age) by lying and standing position) and some cross check is advised at some context using longitudinal data and hospital data as well.

**References**


1. Ashraf Aminorroaya, Masoud Amini, Habib Naghdi, and Akbar Hasan Zadeh;Growth Charts of Heights and Weights of Male Children and Adolescents of Isfahan, Iran; J HEALTH POPUL NUTR, 2003 Dec;21(4):341-346
2. WHO Multicentre Growth Reference Study Group: WHO Child Growth Standards. Length/ height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-forage: methods and development. Geneva, World Health Organization, 2006
3. Stef van Buuren, Jacobus P van Wouwe.; WHO Child Growth Standards in action, Arch Dis Child, July 2008 ,Vol 93, No 7.
4. Diego Augusto Santos Silva, Andreia Pelegrini, Edio Luiz Petroski, Adroaldo Cesar Araujo Gaya. Comparison between the growth of Brazilian children and adolescents and the reference growth charts:data from a Brazilian project. *J Pediatr (Rio J). 2010;86(2):115-120*.
5. Hui LL, Schooling CM, Cowling BJ, et al. Are universal standards for optimal infant growth appropriate? Evidence from a Hong Kong Chinese birth cohort. Arch Dis Child 2008;93:561–5.
6. Kim Fleischer Michaelsen, WHO Growth Standards—Should They Be Implemented as National Standards? JPGN _ Volume 51, Supplement 3, December 2010.
7. MATHIEU ROELANTS et al. Breastfeeding, growth and growth standards: Performance of the WHO growth standards for monitoring growth of Belgian children, Annals of Human Biology, January–February 2010;

37(1): 2–9

8. Zbigniew Kulaga, Mieczysław Litwin, Marcin Tkaczyk, Agnieszka Różdżyńska, Katarzyna Barwicka,Aneta Grajda, Anna Świąder, Beata Gurzkowska, Ewelina Napieralska, Huiqi Pan. The height-, weight-, and BMI- Polish school-aged children and adolescents relative to international and local growth references. Kulaga et al. BMC Public Health 2010, 10:109.
9. Fred Arnold, Sulabha Parasuraman, P. Arokiasamy, and Monica Kothari. 2009.
10. *Nutrition in India*. National Family Health Survey (NFHS-3), India, 2005-06.
11. R Development Core Team. *R*: *A Language and Environment for Statistical Computing. R Foundation for Statistical Computing: Vienna, 2006.*
12. Rigby RA, Stasinopoulos DM. Smooth centile curves for skew and kurtotic data modelled using the Box-Cox power exponential distribution. Stat Med 2004;23:3053-76.
13. Stasinopoulos DM, Rigby RA, Akantziliotou C. GAMLSS package in R, version 0.3-5 2004. (available from the authors).
14. Stasinopoulos DM, Rigby RA, Akantziliotou C: The GAMLSS Package**.** R help files 2006.
15. Stasinopoulos DM, Rigby RA. Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software* 2007; **23**:1–46
16. Stasinopoulos M, Rigby B, Akantziliotou C. *Instructions on How to Use the gamlss Package in R (2nd edn).2008; 206.*
17. Bob Rigby and Mikis Stasinopoulos .A flexible regression approach using GAMLSS in R June 27, 2008.
18. Stef Van Buuren , Fredriks M. Worm plot. A simple diagnostic device for modeling growth reference curves. Statistics in Medicine 2001; 20:1259–1277.
19. Royston P, Wright EM (2000). Goodness-of-fit statistics for age-specific reference intervals.; *Stat Med* **19:** 2943-2962.
20. Ch.Lakshmi Sujatha, M. Vishnu Vardhana Rao (2014) A new nonparametric method of estimation of Prediction limits and comparison of its performance with semi parametric method; Advances and Applications in statistics, vol 42, Number 1, 2014, pp 33-46.