# PERCENTILE CURVES FOR BODY-MASS INDEX OF PUNJABI INFANTS

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**Objective:** *To study percentile distance growth pattern of Body Mass Index (BMI) of Punjabi male and female infants.* **Design:** *Longitudinal.* **Setting:** *Growth Clinic.* **Subjects:** *154 Punjabi infants (Male 86; Female 68), aged birth-12 months.* **Follow-up:** *Nude body weight and crown-heel length of all babies at birth and whereafter, were measured at monthly age intervals with. time tolerance to ±3 days by the same investigator upto 22 months of life.* **Results:** *Mean (± SD) values for BMI measured 12.2 ± 1.40 kg/m$^2$ and 16.5 ± 1.40 kg/m$^2$ at birth and 12 months, respectively in male infants. The corresponding figures for female infants were 12.5 ± 1.60 kg/ m$^2$ and 16.5 ± 1.50 kg/m$^2$. A rapid increase in BMI values amongst infants of both sexes between birth to about six months followed by flattening of curves up to 12 months of age indicates an age dependent nature of BMI during first half of infancy in comparison to latter half during which these demonstrated stable trend. These findings are in contrast to those of the western infants who showed a regular increase in BMI throughout the first year of life. Sex differences were not significant at majority of the age levels.* **Conclusions:** *Percentile grids presented for BMI represent a normal, healthy and well-nourished infant population which can be used to assess the adiposity status of infants of the two sexes during the first year of life.*

*Key words: Body mass index, Infant.*

BODY-MASS index (BMI) is considered to be an important measure of body build of an individual(l-4). It is frequently used as an index of obesity or undernutrition(5). The utility of BMI, besides being an index of obesity(6-9) has also been demonstrated as a tool which can predict obesity in later life(l0-ll). The relative risk of fat infants to become obese adults as compared to non-fat infants was reported to be substantially higher in Czech subjects examined from the age of one month to adulthood(ll). The need for age, sex and race specific normative data on BMI is obvious, since earlier work suggests that this index is influenced by the above named factors(12).

Direct assessment of adiposity using hydrostatic weighing and other techniques(13) is not feasible in studies involving infants and young children. Therefore, anthropometric methods of estimating adiposity by measurement of body weight, height and skin fold thickness are used for this purpose. However, measurement of skin fold thickness shows a high degree of variability(14-17), which limits the usefulness for this purpose. Reference data on BMI(18) including percentile curves(13) have been developed to monitor adiposity level of white children and adolescents belonging to industrially advanced countries.

The published data on BMI for the

clinical assessment of adiposity in Indian infants and children is scarce. However, some researchers have used weight/ height$^2$(19-20) index to detect PEM in children of pre-school ages while others(21-23) have found this ratio as useful age independent tool to assess nutritional status in the community. The results presented by these workers only covered the ages beyond one year of life, and the period of infancy, *i.e.,* birth to 12 months of age remained unexplored. The values presented by Prasad and Rangaswamy(21) at pooled monthly age groups during the first year of life cannot be considered to be as precise as those obtained exactly at monthly age points. The report published by these authors was based on a sample of inadequate size. We have attempted to present percentile curves for body mass index derived from longitudinal data, based on 86 male and 66 female infants.

## Subjects and Method

Longitudinally collected data(24) on body weight and crown-heel length of 154 (male 86 and female 68) Punjabi infants followed at monthly age intervals comprised the material for this presentation. Each subject was born to Punjabi parents and had gestation over 37 weeks and weight more than 2.5 kg at birth. Other criteria employed to enroll subjects in the present study included; *(i)* selection of Punjabi parents *(i.e.,* parents who used Punjabi as their language for daily conversation and who traced their ancestral place of origin to any place located in the present day Punjab province); *(ii)* exclusion of babies with adverse perinatal factors as birth asphyxia, trauma or suspected to be suffering from any disease of central nervous system or from any other congenital anomaly; *(iii)* permanent residence in Chandigarh and *(iv)* willingness of the parents to participate in this longitudinal study.

Weight and crown-heel length measurements at birth were taken by one of us (AKB) in the labor room attached to the Department of Obstetrics and Gynecology within 24 hours of the birth. Nude body weight was measured to the nearest 20 g using a beam balance provided with a pan (make Detecto baby scale; capacity 16 kg Crown-heel length was measured up to the accuracy of 0.1 cm following standardized techniques presented elsewhere(24). Except for one, all infants were breastfed from birth to six months. However, fewer than 5% of the mothers continued breastfeeding their infants until one year of age. In 89.6°/ of infants a semi-solid diet was introduced after 5 months of age, but in some (6.5%) this was done as early as 3 months of age Mothers of 3 infants (2%) did not introduce semisolids into the diet schedule of their babies until the age of 8 months despite medical advice(24).

Subsequently, the subjects were measured in Growth Clinic of the Department of Pediatrics at one monthly intervals win a time tolerance of ±3 days on the day of measurement. The infants who could now be brought to the clinic on the given data were examined in their homes on next day. Other salient characteristics of the sample and methods followed are given else where(25).

The body-mass index was calculated as body weight (kilograms) divided by square of crown-heel length converted in meters. Mean and SD were calculated at each age level. Seven distance percentile (3$^{rd}$, 10$^{th}$, 25$^{th}$, 50$^{th}$, 75$^{th}$, 90$^{th}$ and 97$^{th}$ were computed from the basic data generated for BMI by using the formulae given by Tanner *et al.* (26).

To minimize the effect of time tolerance limit on the variance of measurement Healy's(27) correction was applied to SD so as to obtain corrected SD, which was finally

been used to compute percentiles.

## Results

Percentile curves *(Figs. 1 & 2)* for BMI of Punjabi male and female infants are based on the values presented in *Tables I & II,* respectively. The longitudinal BMI curves plotted for Punjabi infants of the two sexes (Figs. *1 &* 2) depict a regular rapid increase in the mean values between birth and first half of infancy, where after, curves show almost stable trend up to 12
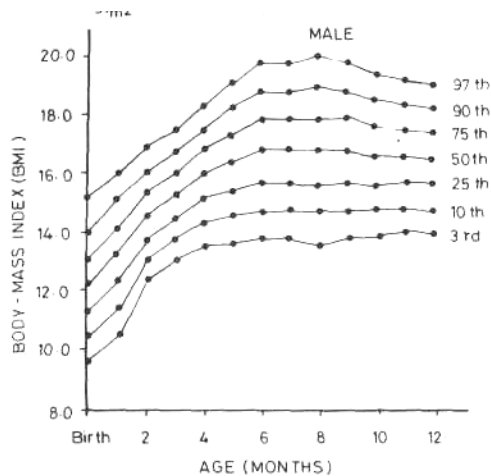


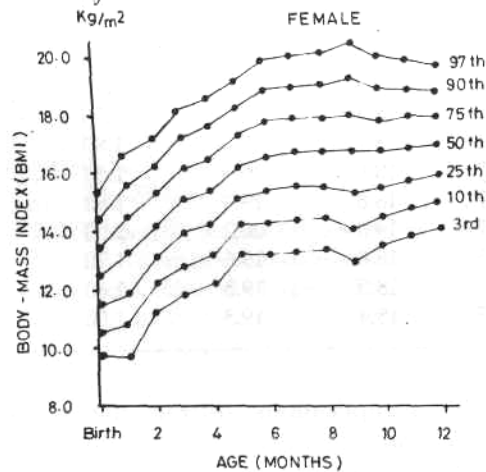Fig. 1. *Age-wise percentile curves in Punjabi male infants.*



Fig. 2. *Age-wisde percentile curves in Punjabi female infants.*

months of age. Mean (± SD) values for BMI measured $12.2 \pm 1.4$ kg/m$^2$ and $16.5 \pm 1.4$ kg/m$^2$ at birth and 12 months, respectively. The corresponding figures for female infants were $12.5 \pm 1.5$ kg/m$^2$ and $16.5 + 1.5$ kg/m$^2$.

Male infants in general, possessed higher mean values for BMI at majority of the monthly age levels as compared to their female counterparts, though the magnitude of the sex differences were significant only at 2 and 4 months of age ($p < 0.05$).

## Discussion

The percentile curves for body-mass index of Punjabi infants have been derived from normative data on body weight and crown-heel length measured longitudinally at one monthly intervals amongst 86 male and 68 female infants. The basic nature of 50th percentile (mean) curves plotted for Punjabi infants demonstrates a regular rapid increase in mean BMI values which peaks at 6 months age in male and at 7 months age in female infants. Where after, a sudden flattening of mean curves occurs and that continues till 12 months of age. This indicates an age dependent nature of BMI during about first half of infancy in contrast to the latter one during which curves depict an almost stable trend. The age dependent nature of BMI between birth and 6/7 months of life (Figs. *1 & 2)* is in sharp contrast to the findings reported for BMI in French(6) and Czech(ll) infants who depicted an uninterrupted increase in BMI during the entire 12 months period of infancy.

The sudden flattening of BMI curves during the second half of infancy appears to be a natural characteristic of our population, which might be controlled by genetic factors. It can not be attributed to malnutrition, as all the infants included in this study enjoyed satisfactory nutritional

TABLE I–*Percentile Values in Punjabi Male Infants*

| Age (months) | Percentiles | | | | | | | Corrected SD | Sex differen (t-valu |
|---|---|---|---|---|---|---|---|---|---|
| | 3rd | 10th | 25th | 50th | 75th | 90th | 97th | | |
| Birth | 9.6 | 10.4 | 11.3 | 12.2 | 13.1 | 14.0 | 14.8 | 1.40 | 1.288 |
| 1 | 10.4 | 11.3 | 12.2 | 13.2 | 14.2 | 15.1 | 16.0 | 1.47 | 0.000 |
| 2 | 12.3 | 13.0 | 13.8 | 14.6 | 15.4 | 16.2 | 16.9 | 1.30 | 1.723* |
| 3 | 13.1 | 13.8 | 14.5 | 15.3 | 16.1 | 16.8 | 17.5 | 1.18 | 1.291 |
| 4 | 13.6 | 14.3 | 15.1 | 16.0 | 16.9 | 17.6 | 18.4 | 1.28 | 2.915* |
| 5 | 13.6 | 14.5 | 15.4 | 16.4 | 17.4 | 18.3 | 19.2 | 1.50 | 1.205 |
| 6 | 13.8 | 14.7 | 15.7 | 16.8 | 17.9 | 18.8 | 19.8 | 1.60 | 1.467 |
| 7 | 13.8 | 14.7 | 15.7 | 16.8 | 17.9 | 18.8 | 19.8 | 1.60 | 1.100 |
| 8 | 13.6 | 14.6 | 15.6 | 16.8 | 17.9 | 19.0 | 20.0 | 1.70 | 1.066 |
| 9 | 13.8 | 14.7 | 15.7 | 16.8 | 17.9 | 18.8 | 19.8 | 1.60 | 1.388 |
| 10 | 13.8 | 14.7 | 15.6 | 16.6 | 17.6 | 18.5 | 19.4 | 1.50 | 0.780 |
| 11 | 14.0 | 14.8 | 15.7 | 16.6 | 17.6 | 18.4 | 19.2 | 1.40 | 0.416 |
| 12 | 13.9 | 14.7 | 15.6 | 16.5 | 17.4 | 18.3 | 19.1 | 1.40 | 0.000 |

* $p \leq 0.05$

TABLE II–*Percentile Values in Punjabi Female Infants*

| Age (months) | Percentiles | | | | | | | Corrected SD |
|---|---|---|---|---|---|---|---|---|
| | 3rd | 10th | 25th | 50th | 75th | 90th | 97th | |
| Birth | 9.7 | 10.6 | 11.5 | 12.5 | 13.5 | 14.4 | 15.3 | 1.50 |
| 1 | 9.6 | 10.8 | 11.9 | 13.2 | 14.5 | 15.6 | 16.7 | 1.89 |
| 2 | 11.2 | 12.2 | 13.1 | 14.2 | 15.3 | 16.2 | 17.2 | 1.57 |
| 3 | 11.8 | 12.8 | 13.9 | 15.0 | 16.1 | 17.2 | 18.2 | 1.68 |
| 4 | 12.1 | 13.1 | 14.1 | 15.3 | 16.4 | 17.5 | 18.5 | 1.70 |
| 5 | 13.1 | 14.1 | 15.0 | 16.1 | 17.2 | 18.1 | 19.1 | 1.58 |
| 6 | 13.0 | 14.1 | 15.2 | 16.4 | 17.6 | 18.7 | 19.8 | 1.80 |
| 7 | 13.1 | 14.2 | 15.3 | 16.5 | 17.7 | 18.8 | 19.9 | 1.80 |
| 8 | 13.1 | 14.2 | 15.3 | 16.5 | 17.7 | 18.8 | 19.9 | 1.80 |
| 9 | 12.6 | 13.8 | 15.0 | 16.4 | 17.7 | 19.0 | 20.2 | 2.00 |
| 10 | 13.2 | 14.2 | 15.2 | 16.4 | 17.5 | 18.6 | 19.6 | 1.70 |
| 11 | 13.5 | 14.4 | 15.4 | 16.5 | 17.6 | 18.5 | 19.5 | 1.60 |
| 12 | 13.7 | 14.6 | 15.5 | 16.5 | 17.5 | 18.4 | 19.3 | 1.50 |

status during first year of life had doubled their birth weight by 4 months and trebled it by 12 months (28). Besides, none of the infants who were being regularly followed experienced any serious health complications during the entire study span. Punjabi infants of the present series possessed lower averages for BMI during the first year of life in comparison to their western counterparts in whom BMI was 13 kg/m$^2$ at birth and 18 kg/m$^2$(29)

at 12 months of age. The higher values recorded for BMI in western infants in comparison to those of Punjabi origin may be attributed to racial and nutritional factors.

It is hoped that the percentile grids for BMI which represent a normal, healthy and well-nourished infant population shall prove useful for the assessment of adiposity status of infants of the two sexes.

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## NOTES AND NEWS

### SECOND ADVANCED COURSE IN PEDIATRIC AND NEONATAL INTENSIVE CARE

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