International Journal of Contemporary Pediatrics
Meda RT et al. Int J Contemp Pediatr. 2026 Jun;13(6):922-927
https://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20261535

Original Research Article

Utility of mid-parental height in predicting linear growth among school-aged children: a cross-sectional study

Ravi Teja Meda*, Lokeswari Balleda, Sravani Kolla, Chandrasekhara Reddy Thimmapuram

Department of Pediatrics, Sri Ramachandra Children's and Dental Hospital, Guntur, Andhra Pradesh, India

Received: 11 March 2026
Revised: 09 April 2026
Accepted: 17 May 2026

***Correspondence:**
Dr. Ravi Teja Meda,
E-mail: drmedaraviteja963@gmail.com

ABSTRACT

Background: Aim was to evaluate the correlation between height of children aged 5-12 years and parental heights, including mid-parental height (MPH).
Methods: This cross-sectional study was conducted from October 2022 to April 2024 at a tertiary care children's hospital in Guntur, Andhra Pradesh. A total of 580 children aged 5-12 years were included. Heights of children and parents were measured using a standardized stadiometer. MPH was calculated using sex-adjusted formulas. Data normality was assessed using the Shapiro-Wilk test, and non-parametric tests were applied as appropriate.
Results: Among the participants, 58.45% were males. The mean age was 101.65±23.4 months, and mean height was 127.72±13.38 cm. Mean father's height was 165.8±7.24 cm, mother's height was 156.23±6.62 cm, and mean MPH was 162.11±8.91 cm. Overall, 33.45% of children were taller than their MPH, 63.62% were within the expected range, and 2.93% were below it. Children's height showed significant positive correlations with father's height ($r=0.275$), mother's height ($r=0.291$), and MPH ($r=0.223$) ($p<0.0001$). No significant association was found with age or gender.
Conclusions: Nearly one-third of children exceeded their MPH, suggesting early growth acceleration influenced by environmental and nutritional factors, supporting the need to revise Tanner's formula and update growth charts.

Keywords: Children, Projected height, Mid parental height

INTRODUCTION

Estimation of a child's final height is of major significance. Height of the children is influenced by parental height. The calculation of MPH is a standard procedure for assessing individual children's genetic potential height.

However, MPH might be limited for assessing short children of parents with extreme height i.e., parents who are unusually tall or short.

Final adult height in children is a complex, polygenic characteristic determined by the interaction of multiple factors. These include genetic predisposition, nutritional status, timing and tempo of growth and maturation, as well as environmental influences operating during intrauterine life, childhood, and adolescence.[1] Accurate prediction of adult height holds considerable clinical importance, particularly for pediatricians and endocrinologists, as it aids in identifying growth disorders, guiding decisions regarding therapeutic interventions, and providing appropriate counseling to families.[2]

One of the most widely used methods to estimate a child's genetic growth potential is the calculation of MPH, originally described by Tanner. This method involves averaging the heights of both parents with adjustment for the child's sex, thereby providing an approximate target height. When plotted at 18 years on standard growth charts, MPH serves as a practical reference to assess whether a child's growth trajectory is consistent with their genetic potential.[3]

In India, the Indian Academy of Pediatrics (IAP) recommended the use of the IAP 2015 growth charts for children aged 5-18 years, while advising the use of simplified World Health Organization (WHO) 2006 growth standards for children below five years of age. To address the limitations of using separate charts, a combined WHO-IAP growth chart has been developed, enabling continuous monitoring of growth from birth to 18 years on a single platform. This integrated approach also facilitates simultaneous assessment of a child's attained height in relation to their MPH, even in children younger than five years, which is not feasible when separate charts are used.

Recent evidence from Indian populations indicates a secular trend toward increasing stature, particularly among boys. Comparative analyses have shown that, relative to 1989 reference data, the 97th percentile for height in children aged 5-18 years increased by approximately 1.7 cm in boys and 2 cm in girls by 2007.[4] These observations likely reflect ongoing socioeconomic development, improved nutrition, and better health care access in the country. As India continues to undergo rapid epidemiological and nutritional transitions, there is a growing need to periodically update growth references to accurately represent current population trends.

For growth charts to be representative at the national level, they must be derived from data encompassing children across diverse socioeconomic strata. Importantly, children from middle- and higher-income groups are often more responsive to improvements in living conditions and may better reflect the impact of positive secular changes in growth patterns. Therefore, the development of contemporary, population-specific growth standards remains essential for accurate growth assessment and clinical decision-making.

This study aims to examine the actual distribution of children's heights and the relation with their parents' heights and MPHs in a local population of Guntur, Andhra Pradesh using WHO and IAP growth charts. Over the last three generations, the children are consistently taller than their parents.

Also, improvements in nutrition through Anganwadis, improvements in environmental and socioeconomic conditions are likely to be enhancing the growth potential through generations. So, the WHO, IAP references/standards which were prepared in 2006, 2015 respectively may not be truly suitable for present day population, in view of current secular trends in the height due to marked social, environmental and economic influences. So, we aim to test the validity of the existing growth charts.

Aims and objectives

Aims

Aims were to study the correlation of heights of children aged between 5 years and 12 years with their mid-parental and individual parental heights.

Objectives

Objectives were to study actual distribution of children's heights aged between 5 years and 12 years and to test the validity of the existing growth charts.

METHODS

This observational cross-sectional study was conducted at Sri Ramachandra Children's and Dental Hospital, Guntur for duration of 18 months (i.e. October 2022 to April 2024) and included children aged 5 to 12 years. Heights of children and parents were measured in standardized way using Stadiometer. Height was measured at a precision of 0.1 cm. MPH s were calculated based on the formula which is adjusted for sex.

Male child MPH=[(father height+mother height+13)/2]±6 cm. Female child midparental height=[(father height+mother height-13)/2]±6 cm.

The data was plotted on WHO 2006-IAP 2015 combined growth charts as per their individual sex (boys & girls). The calculated target height was plotted at 18 years on the growth chart.

Inclusion criteria

Children aged 5 to 12 years and parents of the children included in the study.

Exclusion criteria

Age of the children less than 5 years and more than 12 years, adopted children and children associated with chronic illness, malnourishment, congenital anomalies, skeletal dysplasias and other malformations were excluded from the study.

Statistical analysis

Sample size: formula used is:- n≥(p (1-p))/(ME/zα)2

Where Zα is value of Z (normal variate) at two-sided alpha error of 5%,

ME is margin of error, p is proportion of children's heights falling within 1.5 SDS (approximately two centile spaces) of their MPHs.

The presentation of the categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means±SD and as median with 25th and 75th percentiles (interquartile range). The data normality was checked by using Shapiro-Wilk test. The cases in which the data was not normal, we used non parametric tests. The following statistical tests were applied for the results:

The association of the variables which were quantitative and not normally distributed in nature were analyzed using Kruskal Wallis test and variables which were quantitative and normally distributed in nature were analyzed using ANOVA. The association of the variables which were qualitative in nature were analyzed using Chi-Square test. If any cell had an expected value of less than 5 then Fisher's exact test was used. Pearson correlation coefficient was used for correlation of father height, mother height and MPH (cm) with child height and for correlation of MPH upper centile with child centile.

The data entry was done in the Microsoft excel spreadsheet and the final analysis was done with the use of statistical package for social sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0.

For statistical significance, p value of less than 0.05 was considered statistically significant

Ethical justification

This study is purely collection of data from children attending OPD as out-children and in-children admitted to the ward, according to the inclusion criteria.

This study did not modify any existing treatment protocol.

This study was approved by the Ethics Committee of the department of pediatrics and DNB institution, Sri Ramachandra children's and Dental Hospital, Guntur, Andhra Pradesh (Approval No.: SRCANDDH/DNB/1/2022).

RESULTS

The mean age of 101.65±23.4 months with an age range of 60-144 months. The 339 (58.45%) were males while 241 (41.55%) were females. The mean child's height in our study was 127.72±13.38 cm; mean father's height was 165.8±7.24 cm and mean mother's height was 156.23±6.62 cm.

The MPH in our study was 162.11±8.91 cm with upper level at 168.11±8.91 cm and lower level at 156.11±8.91 cm (Table 1).

On comparing the association of children's current height centiles with MPH distribution, 369 (63.62%) were within MPH, while 17 (2.93%) were below MPH and 194 (33.45%) were above MPH (Table 2). The child height was in direct correlation with father's height (r=0.275, p<0.0001), mother's height (r=0.291, p<0.0001), and MPH (r=0.223, p<0.0001) (Table 3). The relationship between children's height centiles and MPH, revealing distinct patterns across various centile ranges. Interestingly, in our study, children with heights above MPH (>MPH+6 cm) were exclusively concentrated in the 91st-97th centile group comprising 85% and followed by >97th centile comprising 72.73%, which was statistically significant (p<0.0001). Conversely, the proportion of children with below MPH (<MPH- 6 cm) was significantly higher in the <3rd centile group comprising 20.83%. P for these observations were statistically significant (p<0.0001) (Table 4).

The child's height (in relation to the MPH) did not show a significant association with age of the children. The proportion of children with height above MPH were statistically comparable in the age groups of 60-84 months, 85-108 months, and 109-144 months (30.31% vs 35.59% vs 34.36%, p=0.522) (Figure 1). There was no significant association of child's height (in relation to the MPH) with gender, as there were equivalent number of females and males with height above MPH (29.34% females vs 36.69% males, p=0.158).

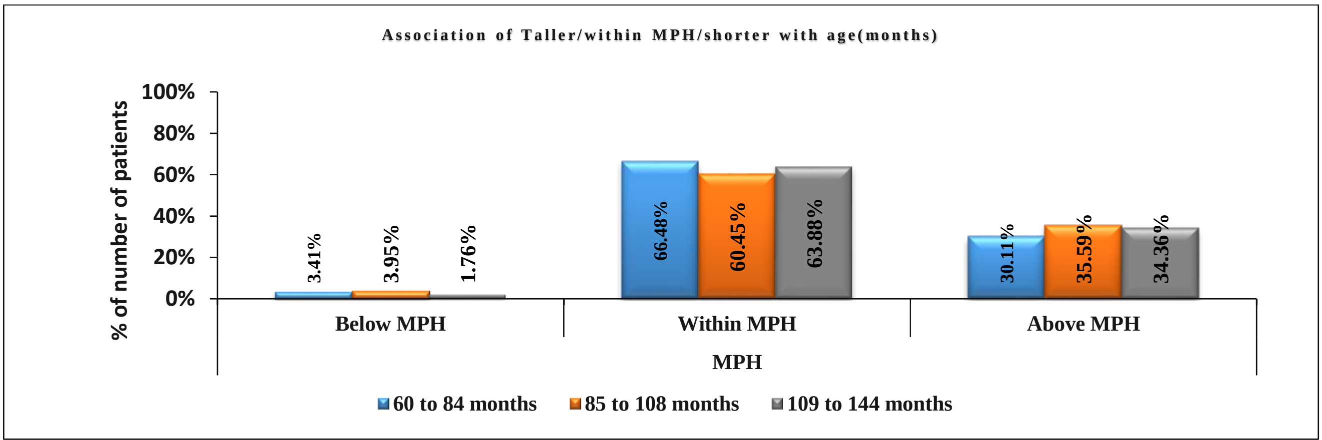

Figure 1: Association of taller/within MPH/shorter with age (months).

Table 1: Descriptive statistics of MPHs (cm).

MPH (cm)	Mean±SD	Median (25th-75th percentile)	Range
Upper range (MPH + 6 cm)	168.11±8.91	168.5 (161-174.86)	142.5-192.4
MPH (cm)	162.11±8.91	162.5 (155-168.86)	136.5-186.4
Lower range (MPH-6 cm)	156.11±8.91	156.5 (149-162.86)	130.5-180.4

Table 2: Comparison of children's current height centile with mid-parental height centile distribution.

Comparison children's centile with MPH centile distribution	N	Percentage
Below MPH (<MPH-6 cm)	17	2.93%
Within MPH (MPH-6 cm to MPH +6 cm)	369	63.62%
Above MPH (>MPH+6 cm)	194	33.45%
Total	580	100.00%

Table 3: Correlation of child height with father height, mother height and MPH (cm).

Child height (cm)	Father height (cm)	Mother height (cm)	MPH (cm)
Correlation coefficient	0.275	0.291	0.223
P value	<0.0001	<0.0001	<0.0001

Table 4: Association of children's current height centile with MPH range (According to WHO 2006, IAP 2015 combined growth chart).

Children's current height centile	<3rd centile, (n=24) (%)	3rd to 10th centile, (n=58) (%)	11th to 25th centile, (n=105) (%)	26th to 50th centile, (n=137) (%)	51th to 75th centile, (n=127) (%)	76th to 90th centile, (n=78) (%)	91th to 97th centile, (n=40) (%)	>97th centile, (n=11) (%)	Total, N (%)	P value (Fisher's exact test)
Below MPH (<MPH-6 cm)	5 (20.83)	4 (6.90)	4 (3.81)	2 (1.46)	1 (0.79)	1 (1.28)	0 (0)	0 (0)	17 (2.93)	<0.0001
Within MPH (MPH +6 to -6 cm)	18 (75)	52 (89.66)	86 (81.90)	103 (75.18)	70 (55.12)	31 (39.74)	6 (15)	3 (27.27)	369 (63.62)	
Above MPH (>MPH+6 cm)	1 (4.17)	2 (3.45)	15 (14.29)	32 (23.36)	56 (44.09)	46 (58.97)	34 (85)	8 (72.73)	194 (33.45)	
Total	24 (100)	58 (100)	105 (100)	137 (100)	127 (100)	78 (100)	40 (100)	11 (100)	580 (100)	

DISCUSSION

The study enrolled 580 children with a mean age of 101.65±23.4 months with an age range of 60-144 months. Out of the 580 children 339 (58.45%) were males while 241 (41.55%) were females. In a similar Indian study conducted by Velayutham et al which took place in Tamil Nadu, the school-going children ranged in age from 4 to 16 years were enrolled.[5] Out of 15,644 children, 8876 (56.7%) were boys and 6768 (43.3%) were girls.

The mean child's height in our study was 127.72±13.38 cm; mean father's height was 165.8±7.24 cm and mean mother's height was 156.23±6.62 cm. The mean mid-parental height in our study was 162.11±8.91 cm with upper level at 168.11±8.91 cm and lower level at 156.11±8.91 cm. In Su et al study, the mean height of boys and girls was 170.72±5.18 cm and 159.35±4.97 cm, respectively.[6] The mean height of their fathers and mothers was 168.38±5.61 cm and 157.03±4.82 cm, respectively. The differences in mean children's heights in these studies were probably due to different age groups in their inclusion criteria

We found that 369 children (63.62%) were within the range of MPH, i.e. MPH±6 cm. In 194 cases (33.45%), the child's height centile was above MPH range, i.e. >MPH + 6 cm, while in 17 cases (2.93%), the child's height centile was below MPH range, i.e. <MPH-6 cm. Significant moderately positive correlation was seen between mid-parental height upper centile i.e., MPH+6 cm, with child's present height centile with correlation coefficient of 0.507, p<0.0001. In corroboration, in the study by Bereket et al on an average, the actual heights of the offspring were taller than their calculated MPH (3.8±5.7 cm in males and 2.7±6.4 in females).[7] In the study by Atluri et al the difference in child's height and MPH difference was 2.34±7.19 in male children and 1.58±5.68 in female children.[8]

Interestingly, we observed that the child's height showed a positive correlation with both the father's height (r=0.275, p<0.0001) and the mother's height (r=0.291, p<0.0001), and this correlation was more pronounced with the mother's height. Similarly, Bereket et al also showed that height of females demonstrated stronger correlation with their mothers compared to fathers (r=0.486 vs. 0.373), while among males, correlation was nearly equal with mother and father (r=0.400 vs. 0.404).[7] Also, when there was a big difference (>2 SDS) between parental heights, offspring's height correlated better with maternal height than paternal height in females (r=0437 vs. 0.196) and males (0.479 vs. 0.064).

In our study, we observed that the children with heights above their mid-parental height range (i.e., greater than MPH+6 cm) were predominantly concentrated in the 91st-97th centile group comprising 85% and the >97th centile group (72.73%), with these findings being statistically significant (p<0.0001). This may indicate that the taller children are growing taller than what would be predicted based on their parental heights (genetic potential) alone, suggesting that factors like nutrition and better living conditions might be contributing positively to their growth, beyond genetic inheritance. Conversely, the proportion of children with below MPH (i.e., less than MPH-6 cm) was significantly higher in the <3rd centile group (20.83%). The p value for these observations was also statistically significant (p<0.0001). This indicates that shorter or stunted children may require environmental stimuli in the form of better nutrition and living conditions to reach their genetic potential for height. In a study by Wright when the difference between the mid-parental and child's height SDS was calculated, 90% of children had values within 1.5 SDS of their mid-parental height SDS, confirming that the currently used range (±2 centile spaces) corresponds approximately to the 90% range.[9]

In our study, specifically, the child's height (in relation to the MPH) did not show a significant association with age and gender of the children. However, among other studies, Bereket et al found that there was slightly stronger correlation of actual height with MPH among females compared to males (r=0.537 vs. 0.487, p<0.01).[7] Atluri et al reported that the difference in average height between the son and daughter was 14.67 cm, indicating a sex correction factor of 7.33 cm, slightly above the 6.5 cm suggested by Tanner.[8]

Strengths

The study includes a reasonable sample size of 580 children, providing a substantial dataset for analysis. This enhances the reliability and statistical power of the study findings.

The discovery that 33.45% of children (i.e above MPH+6cms range) surpass their expected height underscores the substantial impact of environmental or health factors on growth potential beyond genetics

The data shows a clear trend between a child's height centile and how much they deviate from their mid-parental height. Children in the higher centiles (91 to 97, and >97th) usually exceed their mid-parental height predictions significantly, probably suggesting better living conditions. In contrast, those in the lower centiles i.e., many children below the 3rd centile are much shorter than their mid-parental height. This probably suggests these children if provided better nutritional, environmental conditions, may attain their target height.

Limitations

The study seems focused on a specific region (Andhra Pradesh, India) and a specific age group (5-12 years old), and limited sample size which may limit the generalizability of the findings to other populations or age ranges.

The study is cross-sectional, capturing data at a single point in time. This limits the ability to establish causality or track changes in height over time. A longitudinal study upto 18 years would be more appropriate for studying growth patterns for the final adult height.

There is lack of details of parameters that can affect the findings of the study, such as bone age, nutritional status, chronic diseases, or other health factors that can significantly impact children's growth and height outcomes, potentially confounding the relationships observed

CONCLUSION

A significant portion of children (33.45%), about one-third, were taller than their mid-parental height (>MPH+6 cm range), with consistent percentages across all ages and genders even in early age group (60-84 months group). Most of these taller children (85%) were in the 91st-97th percentile, and 72.73% were above the 97th percentile. Conversely, 20.83% of children below the MPH were under the 3rd percentile. These patterns suggest early growth spurts and highlight the need for ongoing monitoring to see if taller children maintain their growth and if shorter children can catch up with proper external stimuli. This emphasizes the importance of considering environmental, nutritional, and socio-economic factors in height predictions and suggests a potential revision of Tanner's formula for MPH. Updating growth charts through new longitudinal studies is recommended to reflect current trends accurately.

Recommendations

Longitudinal studies should be conducted to track the growth trajectories of children over time. This would provide insights into how genetic factors interact with other environmental and developmental influences on height changes throughout childhood and adolescence.

These type of multicentric, longitudinal studies may play a determine the probable need for revision of the current modified WHO-IAP growth charts and Tanner's target height formula.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee (Approval No.: SRCANDDH/DNB/1/2022).

REFERENCES

1. Tanner JM, Israelsohn W. Parent-child correlations for body measurements of children between the ages of one month and 7 years. A Ann Hum Genet. 1963;26:245-53.
2. Koziel S. Relationships among tempo of maturation, midparent height, and growth in height of adolescent boys and girls. Am J Hum Biol. 2001;13(1):15-22.
3. Tanner JM. Normal growth and techniques of growth assessment. Clin Endocrinol Metab. 1986;15(3):411-51.
4. Tanner JM, Whitehouse RH, Marshall WA. Prediction of adult height from height, bone age, and occurrence of menarche, at ages 4 to 16 with allowance for midparent height. Arch Dis Child. 1975;50(1):14-26.
5. Velayutham K, Selvan SSA, Jeyabalaji RV, Balaji S. Prevalence and etiological profile of short stature among school children in a South Indian population. Indian J Endocrinol Metab. 2017;21(6):820-2.
6. Su PH, Wang SL, Chen JY. Estimating final height from parental heights and sex in Taiwanese. Hum Biol. 2007;79(3):283-92.
7. Bereket A, Bugur IS, Guran T, Atay Z, Ekberzade A, Gurbanov Z. Reconsideration of mid-parental height calculation. ESPE. 2016;86:813.
8. Atluri S, Bharathidasan K, Sarathi V. Tanner's target height formula underestimates final height in Asian Indians-A cross-sectional observational study. Indian J Endocr Metab. 2018;22(4):441-4.
9. Wright CM, Cheetham TD. The strengths and limitations of parental heights as a predictor of attained height. Arch Dis Child. 1999;81(3):257-60.

Cite this article as: Meda RT, Balleda L, Kolla S, Thimmapuram CR. Utility of mid-parental height in predicting linear growth among school-aged children: a cross-sectional study. Int J Contemp Pediatr 2026;13:922-7.