DOI: 10.4274/jcrpe.galenos.2025.2025-2-1

Research Article

Comparison of Methods Used for Final Height Prediction in Central Precocious Puberty Patients

Turan NN et al. Height Prediction Methods in Precocious Puberty

Nisa Nur Turan[1], Aşan Önder Çamaş[2], Burçin Çiçek[2], Merve Nur Hepokur[2], Hamdi Cihan Emeksiz[2]
[1]Medeniyet University Goztepe Prof. Dr. Suleyman Yalcin City Hospital, Pediatric Clinic
[2]Medeniyet University Goztepe Prof. Dr. Suleyman Yalcin City Hospital, Pediatric Endocrinology Clinic, Istanbul, Turkey

What is already known on this topic?
The BP and RWT methods are commonly used for predicting target height.

What this study adds?
The BAPCPHE method is more practical for use in outpatient setting. It provides efficient and accurate data in the final height estimation.

Abstract
Introduction: Various methods are used to estimate target height in patients diagnosed with precocious puberty. These methods include the Bayley-Pinneau (BP) and Roche-Wainer-Thissen (RWT) methods. In addition to these methods, in our clinic, we routinely use a practical approach based on the percentiles in growth charts. In this method, the bone age percentile is projected to the end of the percentile curve (at 18 years of age) to estimate the final adult height. We have named this method BAPCPHE (Bone Age Percentile Curve Projected Height Estimation). This study aimed to retrospectively compare the effectiveness of these three methods in predicting target height in patients treated for central precocious puberty and who have reached their final height in our pediatric endocrinology clinic.
Materials and Methods: 50 female patients were included. The predicted adult heights (PAH) were calculated at treatment initiation, at the end of the first, second, and third years of treatment, and at the time of final height attainment using the BP, RWT, and BAPCPHE methods, based on the patients' heights and bone ages.
Results: When the agreement between the PAH calculated by three methods and the final height was analyzed using the Intraclass Correlation Coefficient (ICC), a statistically significant agreement was found for PAH by the BAPCPHE method at the third year. Among the methods, the strongest agreement with final height and PAH was observed with the BP method at the end of treatment, followed by the BAPCPHE method.
Conclusion: The BAPCPHE method not only measures percentile chart and bone age data, but also allows estimation of PAH quickly, making it a valuable tool in the outpatient setting. Given its simplicity and accuracy, we found the BAPCPHE method preferable.
Keywords: Precocious puberty, predicted adult height, bone age, Bayley-Pinneau, Roche-Wainer-Thissen

Correspondence: Ass. Prof. Dr. Aşan ÖNDER ÇAMAŞ, Göztepe Prof. Dr. Süleyman Yalçın Sehir Hastanesi, Pediyatrik Endokrinoloji Klinigi, Istanbul, Turkey.
asanonder@yahoo.com
0000-0002-5730-3198
03.02.2025
26.06.2025

Epub: 07.07.2025

Introduction

Puberty is a transitional phase in children characterized by accelerated growth, the development of secondary sexual characteristics, physical and psychosocial maturation (1). Precocious puberty (PP) refers to the onset of secondary sexual characteristics before the age of 8 in girls and 9 in boys (2). Early initiation of treatment in central precocious puberty (CPP) management is effective in preserving adult height; hence, the assessment of predicted target height is crucial in the follow-up of these patients (3).
Various methods are used to estimate predicted adult height (PAH) in patients diagnosed with precocious puberty. The Bayley-Pinneau (BP) method estimates final height using the child's current height and bone age, determined according to the Greulich and Pyle bone atlas (4). The Roche-Wainer-Thissen (RWT) method predicts adult height based on height, weight, mid-parental height (calculated from parental heights), and bone age recorded during a single pediatric visit (5). Considering that BP and RWT methods are time consuming in practice, we searched for a faster method. It should also be kept in mind that the bone atlas data used were based on data from the 1930-1950 period in the USA, when puberty started later. The final height estimates made with this atlas data may not be suitable for the children of our country and the present time. In addition to these methods, a practical approach employed in our clinic involves a method based on growth percentile curves numerically defined by Neyzi et al. (6). Using the percentile curves, bone age is plotted, and the projection of the percentile line at age 18 is considered the predicted final height. We have termed this method Bone Age Percentile Curve Projected Height Estimation (BAPCPHE).
In this study, we aimed to retrospectively compare the effectiveness of BAPCPHE and two other methods (BP, RWT) in estimating PAH in patients diagnosed with CPP who underwent treatment and achieved their final height.

Materials and Methods

Patients diagnosed with CPP, followed up/treated, without any additional chronic diseases, and who had reached their final height (defined as bone age ≥14 years in girls and growth velocity <2 cm/year) were included in the study. Leuprolide acetate 3.75 mg/month or 11.25 mg/3 months was used as the treatment agent in all cases. Exclusion criteria were defined as the presence of additional chronic diseases, history of mass/trauma/radiotherapy in the hypothalamic-pituitary region, syndromic disorders, or treatment for other conditions. Patients who discontinued treatment were also excluded from the study.
A total of 2,000 patients diagnosed with CPP and presenting to the pediatric endocrinology outpatient clinic of our hospital between 2015 and 2023 were screened via patient files and the hospital information system. 50 female patients meeting all study criteria were selected. Ethical approval for the study was obtained from our hospital's Ethics Committee (dated 20/12/2023, approval number: 2023/0966). Informed consent was also obtained from the participating patients.
Demographic characteristics, medical history, anthropometric measurements, pubertal findings (Tanner stages), laboratory results, imaging studies, parental heights, and mid-parental height (MPH) values of the patients were retrospectively collected from patient files. The heights

of the parents of the patients who came to our outpatient clinic were measured in our clinic. In rare cases, the heights of parents who could not come to our outpatient clinic were measured in a health institution close to them and recorded.
The treatment initiation date was considered as month 0. Heights, height standard deviation scores (SDS), body weights, body weight SDS values, and bone ages were recorded at months 12, 24, and 36 following the start of treatment, as well as at the end of treatment.
Mid-parental height (MPH) was calculated using the following formula:

- For girls: [mother's height (cm)+father's height (cm)−13]/2
- For boys: [mother's height (cm)+father's height (cm)+13]/2

The age at final height attainment, final height, and final height SDS values were recorded for all patients.
Height was measured using a Harpenden stadiometer with a precision of 0.1 cm (SECA, Hamburg, Germany). Height standard deviation scores (SDS) were calculated using reference data prepared for Turkish children through the Anthropometry Calculation Program (Child Metrics), an online tool developed by the Pediatric Endocrinology and Diabetes Association (ÇEDD) based on the standards published by Neyzi et al (7).
Body mass index (BMI) was classified as follows: underweight (<5th percentile), normal weight (5th–85th percentile), overweight (85th–95th percentile), and obese (>95th percentile). A BMI SDS >2 SDS was defined as obesity (8,9).
Breast and pubic development were staged using the Tanner staging system during physical examinations performed by a pediatric endocrinologist (10,11). The presence or absence of axillary hair was also recorded.
Basal levels of Follicle Stimulating Hormone(FSH), Luteinising Hormone (LH) and esratidole (E2), as well as stimulated LH and FSH levels, were assessed. Basal LH, FSH, and E2 tests were conducted between 8:00 and 10:00 AM. A basal LH level of ≥0.3 IU/L was considered significant for diagnosis. In cases with non-diagnostic basal LH levels and/or ambiguous clinical findings, a Luteinizing Hormone Releasing Hormone (LHRH) stimulation test was administered. A peak LH level of ≥5 IU/L or a peak LH/FSH ratio >0.66 was considered consistent with precocious puberty (12,13,14).
A single-view radiograph of the left hand and wrist was obtained for all patients. All bone age measurements were determined by two pediatric endocrinologists (Reader1 and Reader 2) using the Greulich-Pyle bone age atlas (15). A bone age-to-chronological age ratio of >1.2 was considered indicative of CPP, and a reduction in this ratio during follow-up was interpreted as a positive response to treatment (16).
Final height predictions based on patients' heights and bone ages at the start of treatment, at the 1st, 2nd, and 3rd years of treatment, and at the time of final height attainment were calculated using the BP, RWT, and BAPCPHE methods.
BP and RWT predictions were performed using the PAH calculation tool of Child Metrics (17,18).
For the BAPCPHE method, PAH was calculated as illustrated in Figure 1.The patient's current bone age and height were plotted on Neyzi's growth percentile chart for Turkish children. The corresponding percentile was then tracked along the growth curve until the age of 18. The final projected value was recorded as the patient's predicted adult height.

Statistical Analysis

Descriptive data in the study are presented as frequency and percentage, and continuous data are expressed as mean ± standard deviation and median (minimum-maximum) values, as appropriate. For categorical variables, the McNemar-Bowker test was used for comparisons of dependent groups, while the Chi-square and Fisher tests were applied for independent groups where appropriate. The normality of the distribution of measurements was assessed using the Kolmogorov-Smirnov test and histogram plots. The difference between measurements with a normal distribution was compared using a One-Sample T-test. For measurements that did not show normal distribution, the Mann-Whitney U test was used for comparisons between groups. The level of agreement between two pediatric endocrinologists to determine bone age was assessed using the ICC (Intraclass Correlation Coefficient). ICC was also utilized to assess the agreement between the predicted adult height (PAH), calculated using three different prediction methods (BP, RWT, and BAPCPHE), and the actual final height achieved by the same individuals. Bonferroni correction was applied for post-hoc analyses. Analyses were performed using IBM SPSS Statistics version 20.

Results

The study was conducted with a total of 50 female patients. The mean age at which the first symptoms appeared was 7.16 ± 0.84 years. The mean age at onset of thelarche was 7.3 ± 0.7 years, while the mean age at onset of pubarche was 8.7 ± 1.6 years. The mean age at onset of axillary hair was 9.3 ± 1.6 years. The mean height SDS at the start of treatment was 1.43 ± 1.24, the mean weight SDS was 1.13 ± 0.92, and the mean BMI SDS was 0.69 ± 0.74.
The mean bone age at the start of treatment was calculated to be 9.7 ± 1.7 years.
When evaluating Tanner stages, 72% (n=36) of patients were in stage T2 and 28% (n=14) were in stage T3. In terms of pubarche stages, 56% (n=28) were in stage P1, 36% (n=18) in stage P2, 6% (n=3) in stage P3, and 2% (n=1) in stage P4. Regarding axillary hair presence, 60% (n=30) of patients had no axillary hair, while 40% (n=20) had axillary hair.
When examining BMI distributions at presentation, no patients were classified as underweight. 68% (n=34) of patients were within the normal weight range, 22% (n=11) were overweight, and 10% (n=5) were obese.
The mean age at the start of treatment was 8.3 ± 1.0 years, and the mean treatment duration was 28.4 ± 11.9 months.
The mean age at the end of the treatment was 10.65 ± 0.27 years. At this time, the mean height SDS was 1.01 ± 1.04, the mean weight SDS was 1.17 ± 0.82, and the mean BMI SDS was 0.93 ± 0.69.
The mean bone age at the end of the treatment was 11.4 ± 0.9 years. The average age of final growth was achieved at 14.1 ± 0.7 years, and the mean final height was 163.0 ± 6.4 cm. The final height SDS was 0.46 ± 1.10.
The mean difference between final height and MPH was 4.9 ± 5.6 cm, and the mean difference between final height SDS and MPH SDS was 1.29 ± 0.94 SDS. The mean difference between MPH and initial height was 24.4 ± 20.3 cm, and the mean difference between MPH SDS and initial height SDS was -2.11 ± 1.49 SDS. The mean difference between final height and initial height was 26.5 ± 7.6 cm, and the mean difference between final height SDS and initial height SDS was -0.96 ± 1.08 SDS.
The ICC between Reader 1 and Reader 2 for the bone age measurements at the first, second and third year of treatment were 0.986 (95% CI = 0.939–0.981, *p* :0.000), 0.976 (95% CI = 0.945–0.989, *p* :0.000) and 0.975 (95% CI = 0.857–0.995, *p* :0.000), respectively.
The relation between final height prediction techniques and final height was evaluated using the ICC. At the end of the 3rd year of treatment, all parameters, except for the PAH using the BAPCPHE method, had a statistically significant correlation with final height. The level of agreement was ranked from highest to lowest, and the highest correlation with final height was observed with the BP model at treatment completion. There was a high agreement between final height and PAH calculated according to BP model at treatment completion, the RWT model at the end of the 2nd year, and the BP model at the end of the 3rd year, respectively. A low agreement was found between final height and PAH calculated according to BAPCPHE model at the end of the 1st year and at the start of treatment, and a moderate level of agreement was observed with other parameters, respectively(Table 1).
When statistical significance of differences between final height and PAH using three different methods was examined, it was found that final height was significantly shorter than the BP predicted adult height at the end of the 2nd year, 3rd year, and at treatment completion (p: 0.007, p: 0.036, and p: 0.004, respectively). No significant difference was found between final height and the other two model predicted adult heights (Table 2).

When comparing the treatment initiation age according to the achievement of target height, patients who reached the BP predicted adult height at the end of the 1st year had a significantly lower median treatment initiation age compared to those who did not (p: 0.032). Patients who reached the RWT predicted adult height at the end of the 3rd year had a significantly higher median treatment initiation age compared to those who did not (p: 0.038). No significant relationship was found between treatment initiation age and other target height achievements. When comparing the treatment duration according to the achievement of target height, patients who reached the RWT predicted adult height at the end of the 3rd year had a significantly shorter median treatment duration compared to those who did not (p: 0.038). No significant relationship was found between treatment duration and other target height achievements.

Discussion

In our study, we retrospectively evaluated 50 female patients diagnosed with idiopathic CPP, treated with GnRH(Gonadotropin Releasing Hormone) analogs, and followed until they reached their final height. Our aim was to assess the accuracy of three different methods for estimating final height.

The study by Baek JW et al. in South Korea, which included 71 female CPP patients, reported an average treatment duration of 27.9 ± 9.0 months, a mean treatment initiation age of 8.5 ± 0.7 years, and a mean MPH of 161.6 ± 3.6 cm. Their findings indicated a significant increase in PAH from 158.7 ± 4.1 cm before treatment to 163.8 ± 4.7 cm afterward, by using the BP method (19). Similarly, in our study, the PAH at treatment initiation was 163.2 ± 6.4 cm using the BP method, increasing to 165.8 ± 6.1 cm in the post-treatment period. These findings suggest that treatment effectively halts bone age advancement, contributing to increased PAH, in line with the literature.

Wu et al.(20), developed a predictive model in 2023 to estimate target height in 258 Chinese girls with idiopathic central precocious puberty. This model incorporated variables such as height SDS at diagnosis, bone age-adjusted height SDS, and MPH. Unlike traditional models, it used bone age-adjusted height SDS instead of the peak LH/FSH ratio as a diagnostic factor. Bone age was assessed using the Greulich-Pyle atlas and Tanner-Whitehouse (TW) methods. The model's predicted target heights closely matched the final heights observed in the cohort.

Studies comparing different methods for predicting final height have shown variability in accuracy. For instance, a study including short-statured girls who did not receive GnRH therapy found that the BP method was the most accurate among three methods (BP, TW, and RWT) (21). Joss et al.(22), highlighted that the BP method provided reliable predictions, while the TW method overestimated final height by 3.9 cm and the RWT method by 6.3 cm . In contrast, Bramswig et al. argued that BP, TW, and RWT methods were equally inadequate in predicting adult height in patients with precocious puberty(23).

Quiroga et al. compared the BP and RWT methods in a cohort of 93 girls with CPP who reached their final height without GnRH treatment. They found that the BP method underestimated the predicted target height by 1.01 cm, while the RWT method overestimated it by 0.96 cm. Despite these differences, they recommended the BP method for its simplicity and practical application in predicting height in early puberty cases (24).

Kağızmanlı et al. found that while the RWT method provided predictions close to the final height, the BP method produced the lowest statistically significant difference between PAH and final height, making it the preferred method (25).

Jang et al. studied 206 patients with CPP and reported an MPH of 160.26 ± 3.62 cm. Using the BP method, PAH at diagnosis was 155 ± 5.71 cm, while the final height was159.3 ± 4.26 cm.. The mean initial height was 133.9 ± 5.15 cm, with a mean final height increase of 25.4 cm (26).

In a study by Matias et al. involving 138 patients, the BP and TW methods were compared. The mean final height was 173.6 ± 5.31 cm. TW method predicted a mean target height of 168.6 ± 6.17 cm and the BP method predicted 172.5 ± 5.12 cm. The BP method's predictions were significantly closer to the final height (27).

In our study, the mean difference between final height and MPH was 4.9 ± 5.6 cm, while the final height SDS – MPH SDS difference was 1.29 ± 0.94 SDS. The mean difference between final height and initial height was 26.5 ± 7.6 cm, and the SDS difference was -0.96 ± 1.08 SDS. PAH at treatment initiation was 163.2 ± 6.4 cm using the BP method, 164.1 ± 4.9 cm using the RWT method, and 163.1 ± 5.6 cm using the BAPCPHE method, respectively. ICC analysis revealed that the BP method showed the highest correlation with final height, followed by the RWT and BAPCPHE methods. All three methods demonstrated satisfactory accuracy in predicting final height.

When assessing the ICC between target height prediction methods and final height at the third year of treatment, all parameters except the BAPCPHE-predicted target height showed statistically significant correlation. The BP method based on post-treatment bone age exhibited the highest agreement with final height. Strong agreement was observed between final height and post-treatment BP predictions, second-year RWT predictions, and third-year BP predictions. Moderate correlation was noted with other parameters, while a weak relation was found with first-year and baseline BAPCPHE predictions.

The differences between all these studies can be attributed to the content of the methods and the patient profile. For example, the inclusion of weight in the RWT method causes obesity to be effective in the assessment of PAH. We did not evaluate our obese patients with subgroup analyses. The age at presentation of obese patients may have influenced the relationship between RWT /BP methods and age at treatment initiation.

There are not enough studies in the literature evaluating the efficacy of PAH methods within treatment period. In our study, we found that all three methods were effective and gave similar PAH results in treatment period. The method we use is not affected by either obesity or mid paranteral height. In addition, the fact that bone ages were evaluated by two different specialists and consistency was found between the evaluations strengthened the results of our study. We think that it can be preferred because it is easy to use in practice and the final height estimates are in agreement with the final height during the whole treatment process.

Study Limitations

This study has several limitations. It is a retrospective study involving a relatively small patient cohort receiving varying doses of GnRH analogs at different pubertal stages. The RWT method recommends horizontal height measurement, whereas our study used standing height measurements due to its retrospective design. Factors such as obesity-related bone age advancement were not statistically analyzed, limiting insights into its potential contribution to final height. CPP is more prevalent in girls. Our study cohort had no male patients achieving final height. The heights of the parents who could not come to our outpatient clinic were not measured in our outpatient clinic but in another health institution close to them. This may have created an error in the calculation of mid parenteral height.

Conclusion

In clinical practice, the BAPCPHE method's practical application allows for quick and easy target height estimation, making it a valuable tool in outpatient settings. Given its simplicity and accuracy, we found the BAPCPHE method preferable.

References

1. Kiess W, Hoppmann J, Gesing J, Penke M, Körner A, Kratzsch J, et al. Puberty - Genes, environment and clinical issues. J Pediatr Endocrinol Metab. 2016;29(11):1229–31.
2. Laron Z. Age at first ejaculation (spermarche) - The overlooked milestone in male development. Pediatr Endocrinol Rev. 2010;7(3):256–7.
3. Fuqua JS. Treatment and outcomes of precocious puberty: An update. J Clin Endocrinol Metab. 2013;98(6):2198–207.
4. Post EM, Richman RA. A condensed table for predicting adult stature. J Pediatr. 1981;98(3):440–2.
5. Roche AF, Wainer H, Thissen D. The RWT method for the prediction of adult stature. Pediatrics. 1975;56:1027.
6. Neyzi O, Saka HN. Türk çocuklarında antropometrik araştırmalar. İstanbul Tıp Fakültesi Mecmuası. 2002;63(3):211–28.

7. Demir K, Konakçı E, Özkaya G, Demir BK, Özen S, Aydın M, et al. New features for child metrics: Further growth references and blood pressure calculations. JCRPE J Clin Res Pediatr Endocrinol. 2020;12(2):125–9.
8. Greydanus DE, Agana M, Kamboj MK, Shebrain S, Soares N, Eke R, Patel DR. Pediatric obesity: Current concepts. Dis Mon. 2018 Apr;64(4):98-156.
9. Aggarwal B, Jain V. Obesity in Children: Definition, Etiology and Approach. Indian J Pediatr. 2018 Jun;85(6):463-471.
10. Carel J claude, Léger J. Precocious Puberty. 2008;
11. Marshall, W. A; Tanner JM. Variations in the pattern of pubertal changes in girls : A survey of middle-class children. Arch Dis Child [Internet]. 1969;44(44):291–303.
12. Cheuiche AV, Guimarães L, Cristina L, Paula P De, Regina I, Lucena S, et al. Diagnosis and management of precocious sexual maturation : an updated review. 2021;
13. G. Guerra-Júnior, V. N. Brito, A. M. Spinola-Castro, C. Kochi, C. Kopacek and PCA, Silva D. Central precocious puberty: revisiting the diagnosis and therapeutic management. Arch Endocr Metab. 2016;
14. Alikasifoglu A, Vuralli D, Gonc EN, Ozon A, Kandemir N. HOR MON E RE SE ARCH I N Changing Etiological Trends in Male Precocious Puberty : Evaluation of 100 Cases with Central Precocious Puberty over the Last Decade. 2015;
15. Chaumoitre K, Saliba-Serre B, Adalian P, Signoli M, Leonetti G, Panuel M. Forensic use of the Greulich and Pyle atlas: prediction intervals and relevance. Eur Radiol [Internet]. 2017;27(3):1032–43.
16. Berberoğlu M. Precocious puberty and normal variant puberty: definition, etiology, diagnosis and current management. J Clin Res Pediatr Endocrinol. 2009;1(4):164-74.
17. Post EM, Richman RA. A condensed table for predicting adult stature. J Pediatr 1981;98(3):440-2.
18. Roche AF, Wainer H, Thissen D. The RWT method for the prediction of adult stature. Pediatrics 1975;56(6):1027-33.
19. Baek JW, Nam HK, Jin D, Oh YJ, Rhie YJ, Lee KH. Age of menarche and near adult height after long-term gonadotropin-releasing hormone agonist treatment in girls with central precocious puberty. Ann Pediatr Endocrinol Metab. 2014;19(1):27.
20. Wu W, Zhu X, Chen Y, Yang X, Zhang Y, Chen R. Development and validation of a model for predicting the adult height of girls with idiopathic central precocious puberty. Eur J Pediatr [Internet]. 2023;1627–35
21. Jeong SW, Cho JH, Jung HW, Shim KS. Near final height in Korean children referred for evaluation of short stature: Clinical utility and analytical validity of height prediction methods. Ann Pediatr Endocrinol Metab. 2018;23(1):28–32.
22. Joss EE, Schmidt HA, Zuppinger KA. Oxandrolone in constitutionally delayed growth, a longitudinal study up to final height. J Clin Endocrinol Metab. 1989;69(6):1109–15.
23. Brämswig JH, Fasse M, Holthoff ML, von Lengerke HJ, von Petrykowski W, Schellong G. Adult height in boys and girls with untreated short stature and constitutional delay of growth and puberty: Accuracy of five different methods of height prediction. J Pediatr. 1990;117(6):886–91.
24. Quiroga D, Bruera MJ, Vidaurre J, Cerda J, Cattani A, García H. What is the best method for estimating final height in patients with precocious puberty? Andes Pediatr. 2022;93(2):214–21.
25. Kağızmanlı GA, Sevim RD, Besci Ö, Acinikli KY, Buran AH, Erbaş İM, et al. Which method is more effective in predicting adult height in pubertal girls treated with gonodotropin-releasing hormone agonist? Hormones. 2023;(22):501–6.
26. Jang HJ, Kwak MJ, Kim YM, Choi SH, Park KH, Yoo HW, et al. Adult height in girls with central precocious puberty without gonadotropin-releasing hormone agonist treatment: a retrospective case-control study. J Yeungnam Med Sci. 2023;40:S81–6.
27. Matias AK, Muginshtein-Simkovitch E, Twig G, Pearl L, Laron Z. Comparison of Commonly Used Methods to Predict the Final Height in Constitutional Tall Stature. JCRPE J Clin Res Pediatr Endocrinol. 2023;15(1):42–5.

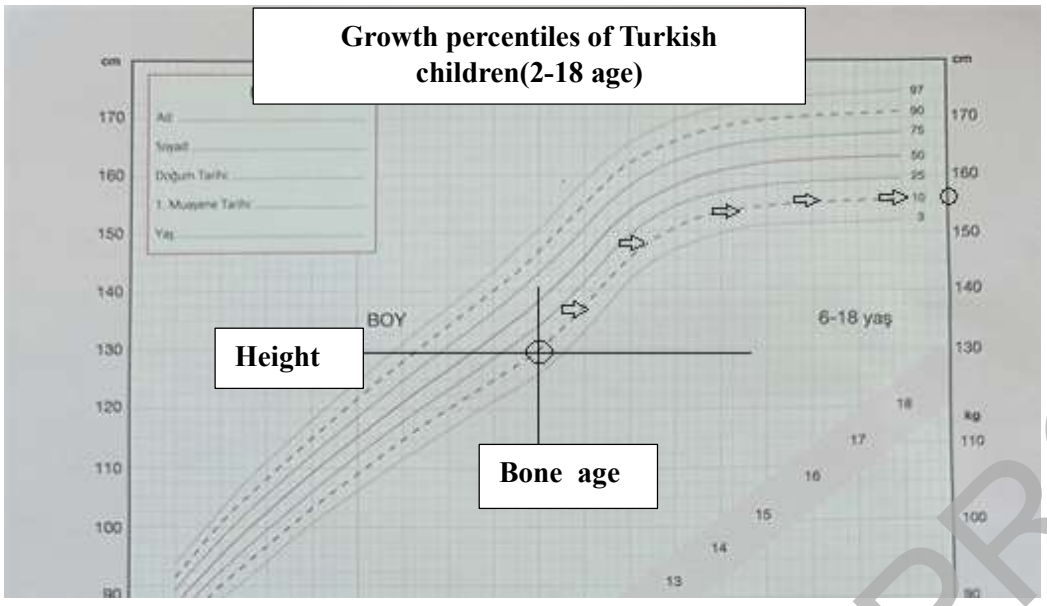

Figure 1: BAPCPHE Method for Calculating Predicted Target Height

Table 1: Analysis of the Agreement Between Predicted Adult Height Calculation Methods and Final Height

	ICC	p
BP Predicted Adult Height at Treatment Initiation	0.504	**<0.001**
RWT Predicted Adult Height at Treatment Initiation	0.639	**<0.001**
BAPCPHE Predicted Adult Height at Treatment Initiation	0.262	**0.032**
BP Predicted Adult Height at the End of the 1st Year of Treatment	0.582	**<0.001**
RWT Predicted Adult Height at the End of the 1st Year of Treatment	0.656	**<0.001**
BAPCPHE Predicted Adult Height at the End of 1st Year of Treatment	0.268	**0.030**
BP Predicted Adult Height at the End of the 2nd Year of Treatment	0.686	**<0.001**
RWT Predicted Adult Height at the End of the 2nd Year of Treatment	0.734	**<0.001**
BAPCPHE Predicted Adult Height at the End of 2nd Year of Treatment	0.449	**0.003**
BP Predicted Adult Height at the End of the 3rd Year of Treatment	0.727	**0.006**
RWT Predicted Adult Height at the End of the 3rd Year of Treatment	0.608	**0.024**
BAPCPHE Predicted Adult Height at the End of 3rd Year of Treatment	0.488	0.076
BP Predicted Adult Height at the End of Treatment	0.749	**<0.001**
RWT Predicted Adult Height at the End of Treatment	0.676	**<0.001**
BAPCPHE Predicted Adult Height at the End of Treatment	0.566	**<0.001**

ICC: In-Class Correlation Coefficient. BP: Bayley-Pinneau method. RWT: Roche-Wainer-Thissen method. BAPCPHE:Bone Age Percentile Curve Projected Height Estimation

Table 2: Analysis of the Difference Between Final Height and Predicted Target Heights Assessed by Three Different Methods

	Target Height	Final Height	*p**
	Target Height - Final Height	Target Height - Final Height	
BP Predicted Adult Height at Treatment Initiation	163.2 ± 6.4	163.0 ± 6.4	0.861
RWT Predicted Adult Height at Treatment Initiation	164.1 ± 4.9	163.0 ± 6.4	0.250
BAPCPHE Predicted Adult Height at Treatment Initiation	163.1 ± 5.6	163.0 ± 6.4	0.948
BP Predicted Adult Height at the End of the 1st Year of Treatment	164.0 ± 6.2	163.0 ± 6.4	0.297
RWT Predicted Adult Height at the End of the 1st Year of Treatment	163.3 ± 4.4	163.0 ± 6.4	0.776
BAPCPHE Predicted Adult Height at the End of 1st Year of Treatment	163.4 ± 6.0	163.0 ± 6.4	0.694
BP Predicted *Adult Height at the End of the 2nd* Year of Treatment	**165.6 ± 7.4**	**163.0 ± 6.4**	**0.007**
RWT Predicted Adult Height at the End of the 2nd Year of Treatment	163.0 ± 4.9	163.0 ± 6.4	0.965
BAPCPHE Predicted Adult Height at the End of 2nd Year of Treatment	164.2 ± 6.4	163.0 ± 6.4	0.208
BP Predicted Adult Height at the End of the 3rd Year of Treatment	**165.0 ± 5.1**	**163.0 ± 6.4**	**0.036**
RWT Predicted Adult Height at the End of the 3rd Year of Treatment	163.0 ± 2.8	163.0 ± 6.4	0.965
BAPCPHE Predicted Adult Height at the End of 3rd Year of Treatment	164.3 ± 4.2	163.0 ± 6.4	0.172
BP Predicted Adult Height at the End of Treatment	**165.8 ± 6.1**	**163.0 ± 6.4**	**0.004**
RWT Predicted Adult Height at the End of Treatment	162.9 ± 4.4	163.0 ± 6.4	0.878
BAPCPHE Predicted Adult Height at the End of Treatment	164.4 ± 4.9	163.0 ± 6.4	0.141

BP:Bayley-Pinneau method. RWT: Roche-Wainer-Thissen method. BAPCPHE:Bone Age Percentile Curve Projected Height Estimation