Original Article

Observation of children's age to predict maximum height

SAPTA KUNTA PURNAMA[1], MUHAMMAD FURQON HIDAYATULLAH[1], FADILAH UMAR[1], SLAMET RIYADI[1], SITI NURUNNIYAH[2], EPPY SETIYOWATI[3], HILWAH NORA[4], AGUS MUKHOLID[5]

[1]*Department Sports Coaching Education, University of Sebelas Maret, Surakarta, Indonesia*
[2]*Midwivery Program, Alma Ata University, Yogyakarta, Indonesia*
[3]*Faculty of Nursing and Midwifery, Nahdlatul Ulama University Surabaya, Indonesia*
[4]*Faculty of Medicine, Syiah Kuala University, Banda Aceh, Indonesia*
[5]*Department Physical Education, Health, and Recreation, University of Sebelas Maret, Surakarta, Indonesia*

ABSTRACT

The ideal height is one of the things that people in Indonesia and around the world want. This study aims to formulate guidelines for predicting the maximum height of men and women. The method used in this research is descriptive. This study observed the growth and development of height for girls aged 0-18 years and boys aged 0-19 years. This research was conducted in the city of Surakarta, Central Java, Indonesia. The research sample was obtained from Posyandu, PAUD, SD, SMP, and SMA. Data were collected by observing the respondent's height. Data analysis used the Miles and Huberman model, namely data reduction, data tabulation, data presentation, and concluding. Measurements for predicting a child's height can be done by considering weight and age percentage. The results showed that predicting a child's height could be done by considering the percentage of weight and age. Every year the growth of the child's height will increase according to the age of growth. Therefore, child height growth data can predict the maximum height of children at the age of 18 years for girls and 19 years for boys. Furthermore, the child height prediction method can be applied to determine the child's height in the future.

Keywords: Physical education, Observation model, Height-for-age, Maximum height, Growth, Development.

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Corresponding author. *Department Sports Coaching Education, Universitas Sebelas Maret, Surakarta, Indonesia.*
https://orcid.org/0000-0003-3371-2613
E-mail: hus.dam@yahoo.com
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INTRODUCTION

Children should grow and develop naturally following the stages of growth and development of the child. Growth and development are unique physiological phenomena in infants and adolescents (Mascherini et al., 2019). Height and weight are important growth indicators and have attracted considerable attention from the family and society (Reinehr et al., 2020; Wang et al., 2018). Adolescence is related to Puberty (Feka et al., 2019; Silva et al., 2021). Puberty is the final stage of children's growth and development in which adult height, reproductive and psychosocial maturity is reached (Abe et al., 2017; Pei et al., 2020).

Height growth is one of the important things in life for certain people. The body needs to be measured to determine height; weight is used to determine a person's health (Li et al., 2017). Anthropometry represents the measurement of the human body (Goss et al., 2019). Anthropometric measurements usually include height, weight, and various body and limb measurements (Agata & Monyeki, 2018).

It is very important to measure age-related height. Child height is an important indicator of human capital and human development (Alves Junior et al., 2021). Health is the beginning of life for humans (Phukan et al., 2021; Sulaiman et al., 2020). Nutrition received by the body can shape the child's height and provide health (Vyas et al., 2016). Therefore, height measurement can be valuable data shaping a child's height growth model (Haile et al., 2016; Socha & Tymińska-Czabańska, 2019). Human physical form is an important measure and is the main capital of health (Spears, 2020).

Children must be able to grow and develop properly. Good growth will affect the movement carried out, such as exercising (Faria et al., 2020; Kim et al., 2021). The growth and development of children are expected to run simultaneously, both cognitive, affective, psychomotor, physiological, psychological, and social (Karra & Fink, 2019). The height achievement of each child is different because each child has a high, medium, and low body (Heshin-Bekenstein et al., 2018). The growth and development of children are influenced, among others, by factors such as conditions before birth (Pomeroy et al., 2021). Prenatal exposure to polychlorinated biphenyls (PCBs) may long-term affect growth in early adulthood among girls and identifies the peri-pubertal period as another sensitivity window for such measures (Bhowmik & Das, 2017; Manzoni et al., 2019; Soekatri et al., 2020). PCB exposure and body size are documented in several periods, from infancy to adulthood (Tahir et al., 2020). Prenatal conditions, reflected in birth weight, are more important in determining the height trajectory than postnatal factors, which do not help children fully recover from early growth deficits (Krishna et al., 2016).

Adolescence will increase children's activity in sports. Children who practice sports are not required to have a proportional height (Mackala et al., 2020). On the other hand, some sports require height, such as volleyball and basketball (S. Shen et al., 2021). In addition, height is one of the components recommended for growth in elementary school to high school (Junior et al., 2019).

Children's height is a concern for several parties in maintaining the health of their children. In addition, nutrition and lifestyle must be maintained for children's health in the future (Priymak et al., 2021; Wijaya-Erhardt, 2019). Height for age reflects the accumulation of malnutrition over the years, affecting children's educational achievement (Adami et al., 2021; A. Shen et al., 2020). To estimate a child's height when growing up, we need a method that can be used to predict a child's height (Ruchman et al., 2020). So that children will be taught to exercise to maintain their physical fitness, this study aims to formulate guidelines for predicting the maximum height of men and women.

MATERIALS AND METHODS

The method used in this research is descriptive development with a cross-sectional technique. The study observed the growth and development of height for girls from 0-18 years old and boys from 0-19 years old. The research was conducted in the city of Surakarta, Central Java, Indonesia. The research sample was obtained from Posyandu, early childhood schools, elementary schools, junior high schools, and high schools. Data were collected by observing the respondents' height (Mustafa et al., 2019). Height should be measured with the child standing straight, without shoes, with his back against the wall. The data were analysed using the Miles and Huberman model, namely data reduction, tabulation, data presentation, and concluding.

RESULTS AND DISCUSSION

The growth and development of female

The results of measuring the growth and development of female height in the study can be seen in Table 1.

Table 1. Age, mean, and percentage of females aged 0-18 years.

No.	Age (Year)	Average (cm)	Percentage (%)
1.	0	47.95	30.73
2.	1	71.25	45.66
3.	2	87.25	55.91
4.	3	95.18	60.99
5.	4	99.17	63.55
6.	5	104.30	66.20
7.	6	113.09	66.54
8.	7	117.09	75.04
9.	8	123.64	79.24
10.	9	127.28	81.57
11.	10	137.89	88.36
12.	11	142.21	91.14
13.	12	150.43	96.40
14.	13	152.38	97.65
15.	14	154.04	98.78
16.	15	154.66	99.11
17.	16	155.52	99.66
18.	17	155.61	99.72
19.	18	156.04	100.00

Table 1 shows that the growth and development of women's height from 13 years shows a stable change. However, growth in height is slow at the age of 13 to 18 years (Nezami et al., 2016). At the age of 16 years, the child did not show changes in height growth. Finally, 17-18 years old showed stagnant changes, meaning that there was no longer an increase in height (Kokun et al., 2021).

Growth and development of male

The results of measuring the growth and development of height for males in the study can be seen in Table 2.

Table 2. Age, mean, and percentage of males aged 0-19 years.

No.	Age (Year)	Average (cm)	Percentage (%)
1.	0	48.22	28.87
2.	1	72.33	43.30
3.	2	88.73	53.13
4.	3	96.46	57.75
5.	4	101.85	60.98
6.	5	106.86	63.98
7.	6	113.44	67.92
8.	7	117.19	70.16
9.	8	123.74	74.09
10.	9	129.21	77.36
11.	10	136.64	81.81
12.	11	140.72	84.25
13.	12	148.00	88.61
14.	13	155.39	93.04
15.	14	160.00	95.80
16.	15	163.41	97.64
17.	16	165.64	99.17
18.	17	166.21	99.41
19.	18	166.71	99.81
20.	19	167.02	100.00

Table 2 shows the growth and development of both male's heights from 0 to 15 years of age. Age 17 years, there is no significant increase in size. Ages 18-19 in males experience stagnant growth (A. Shen et al., 2019). Stagnant growth means that at the age of 18-19 years, males do not experience height growth.

Comparison of the percentage of growth and development of height for women and men

The results of measuring the growth and development of height for women and men in the study can be seen in Table 3.

Measurements for predicting a child's height can be done by considering weight and age percentage. The formula for calculating maximum height can be seen below

Maximum Height = 100% **:** Total Percentage **X** - height at age

Assume that child A is a boy who is 6 years old and 114 cm tall. Then it can be obtained by 100% divided by 63.98 and multiplied by 114 cm then the result is 178.68 cm. Then the child, based on the prediction, will have a maximum height of 178.68 cm when he is 19 years old. Thus, heritability for human height, which measures the relative importance of additive genetic factors and environmental factors in expressing a trait, has been consistently estimated (Subekti et al., 2020). First, of course, from the nutritional factors needed, protein for cell growth and repair, calcium for bones, followed by balanced nutrition from other sources (Acharya et al., 2020; Dogbe & Revoredo-Giha, 2021; Sinharoy et al., 2021). While the environment, in this case, means exercise to circulate blood and help the metabolism run properly (Valencia et al., 2021). However, it should be noted that height gain can be made if the growth plates in the long bones are still open (Saadat Mostafavi et al., 2021). This is because the plate opens at puberty and will generally close at 20-21

years (Agostinete et al., 2017). Therefore, in theory, your growth plate is likely to be/already closed, and if it has closed, then your growth potential.

Table 3. Age and percentage of female aged 0-18 years and male old 0-19 years.

No.	Age (Year)	Percentage	
		Female	Male
1.	0	30.73	28.87
2.	1	45.66	43.30
3.	2	55.91	53.13
4.	3	60.99	57.75
5.	4	63.55	60.98
6.	5	66.84	63.98
7.	6	72.47	67.92
8.	7	75.04	70.16
9.	8	79.24	74.09
10.	9	81.57	77.36
11.	10	88.36	81.81
12.	11	91.14	84.25
13.	12	96.40	88.61
14.	13	97.65	93.04
15.	14	98.78	95.80
16.	15	99.11	97.64
17.	16	99.66	99.17
18.	17	99.72	99,41
19.	18	100.00	99.81
20.	19		100.00

CONCLUSION

Every year the growth of the child's height will increase according to the age of growth. Data on the growth of children's height can predict the maximum height of children at the age of 18 years for girls and 19 years for boys. The results of this study can be used to predict the development of children's height. This research is expected to provide a way to determine children's height in the future. The method of predicting a child's height can be applied to determine a child's height in the future. This method provides an overview of the child's height as an adult. This research is expected to provide information for parents, health workers, and children to maintain physical fitness. It is recommended to do sports that burden the long bones of the legs, such as athletics, leisurely running, skipping, basketball, badminton and other similar sports. In this way, the bones are stimulated to grow a little more due to the pounding of the weight. Swimming can also increase a person's height.

AUTHORS CONTRIBUTIONS

Sapta Kunta Purnama conceived and designed the analysis. Muhammad Furqon Hidayatullah designed the data analysis. Fadilah Umar collected the data. Lamet Riyadi contributed data. Siti Nurunniyah performed analysis tools. Eppy Setiyowati performed the analysis. Hilwah Nora wrote the paper. Agus Mukholid wrote the paper.

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DISCLOSURE STATEMENT

No potential conflict of interest were reported by the authors.

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