http://dx.doi.org/10.30651/jqm.v7i1.13979

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Research Article

Relationship of mid-parental height, Calcium intake, and intensity of physical activity with body height growth of high school students in Malang

Arif Kusuma Firdaus[1], Anung Putri Illahika[1*], Annisa Hanifwati[1], Hanna Cakrawati[1]

1) Faculty of Medicine University of Muhammadiyah Malang

ARTICLE INFO

Submitted : *19th July 2022*
Accepted : *04th November 2022*
Published : *31st January 2023*

Keywords:

Mid-Parental Height, Calcium, Physical Activity, Body Height

Correspondence:
putri@umm.ac.id

This is an Open acces article under the CC-BY license

ABSTRACT

Stunting is one of Indonesia's problems, as portrayed in RISKESDAS 2018. This means the growth of Indonesian children was not optimal. Some factors that might affect body height growth were genetic factors, represented by mid-parental height, nutritional factors, especially calcium, and physical activity, which could activate pathways to stimulate growth. These factors were known to have a huge role in body height growth, especially if these factors were optimized in adolescence, as in high school students. This research aimed to explain the relationship between body height growth and the factors that might affect it: mid-parental height, calcium intake, and the intensity of physical activity. This research was observational analytic, using purposive sampling as the sampling method and collecting data using a cross-sectional questionnaire. Statistical analysis between variables shows that mid-parental height was positively related ($p<0.05$, r: 0,356), while calcium supplementation was not associated ($p<0.05$, r: -0.165), and intensity of physical activity was not related ($p=0.059$, r: 0.089) with the body height growth of the students. In conclusion, among the factors that were analyzed, mid-parental height was the only one that had a relationship with body height growth.

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

INTRODUCTION

Stunting was one of the problems in Indonesia portrayed in RISKESDAS 2018. It shows that 4,5% of teenagers (16-18 years old) were still very short, and 22,4% of the population was classified as short. This problem means that the growth of Indonesian children was not optimal (Riskesdas Jatim, 2018). Mid-parental height is a tool that is used in clinical practices to determine the potential final height that could be attained by a child based on the height of the parents (IDAI, 2017). This measurement represents genetic factors, in a very simple way, which have a huge role in a child's growth (Garza et al., 2013). The nutritional factor was also known to have critical roles in the growth process. Without sufficient nutrition, the growth could be stunted (Gat-Yablonski & Phillip, 2015). One of the most important nutrients in body height growth is calcium, whereas this nutrition is one of the main components of bone (Sherwood, 2016). Besides those factors, physical activity was also publicly known to affect body height growth. This happened because physical activity could activate pathways by increasing the hormones and growth factors that stimulate growth (Bajer et al., 2015).The growth process itself mainly happens in adolescence, around the age of 16-18 years old, depending on the gender of the child (Guyton & Hall, 2019), and in Indonesia, children this age attend high school. It was publicly known that optimization of the factors described above in this phase was vital to achieving optimal final adult height. This research aimed to explain the relationship between mid-parental height, calcium intake, and intensity of physical activity with the growth of high school students.

METHODS

This research was cross-sectional observational analytics research. The data was collected using a questionnaire with two data collection instruments: SQ-FFQ (Semi Quantitative-Food Frequency Questionnaire) to collect calcium intake data of the students, and GPAQ (Global Physical Activity Questionnaire) to assess the intensity of physical activity of the students. The population of this research was students of 10 state and private high schools in Malang that agreed to participate in the study. Based on the calculation, the minimum number of samples was 116, and purposive sampling was used as the sampling method. The relationship of every variable was analyzed using the Spearman correlation test. This research was approved by the Health Research Ethic Committee of University of Muhammadiyah Malang through ethical approval No.E.5.a/020/KEPK-UMM/I/2022.

RESULTS

This research involves 152 students as the samples. The profile of the samples containing minimal, maximal, and average values of age, body height percentile, mid-parental height percentile, calcium intake, and intensity of physical activity is shown in table 1.

The data from every variable is then classified into categories. In the "body height" variable, 19 students, or 12% of the total sample, was classified as "very short". While 41 students or 27% of students, was "short". 88 students or 58% have "normal" body height. 4 students or 3% of the total sample was "tall", and none of them were classified as "very tall". The result was also shown in Figure 1.

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Table 1. Demographic profile of the sample

No	Characteristics	Minimal	Average	Maximal
1	Age	15 years 11 months	17 years 5 months	20 years 6 month
2	Body Height Percentile	0th	27.8th	93.5th
3	Mid-Parental Height Percentile	0th	20.1th	81.4th
4	Calcium Intake	63 mg/day	755 mg/day	4237 mg/day
5	The intensity of Physical Activity	13 MET/day	1093 MET/day	8817 MET/day

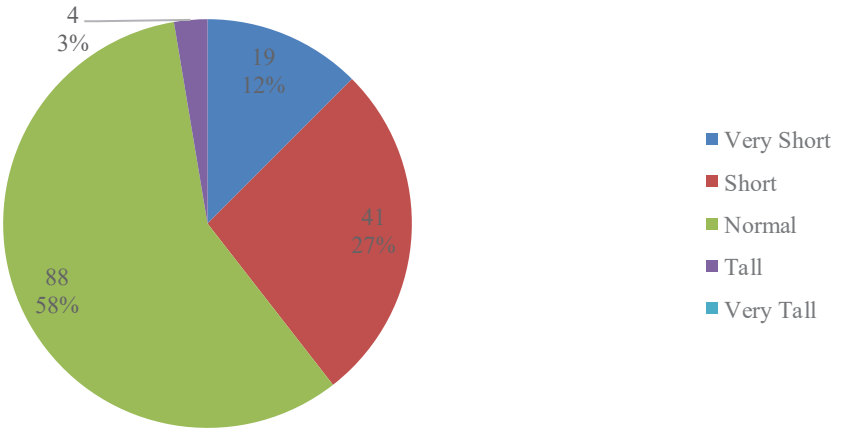

Figure 1. Classification of body height growth variable

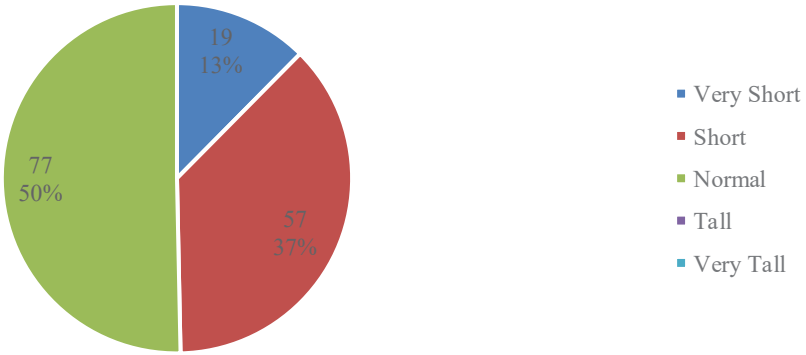

Figure 2. Classification of mid-parental height variable

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

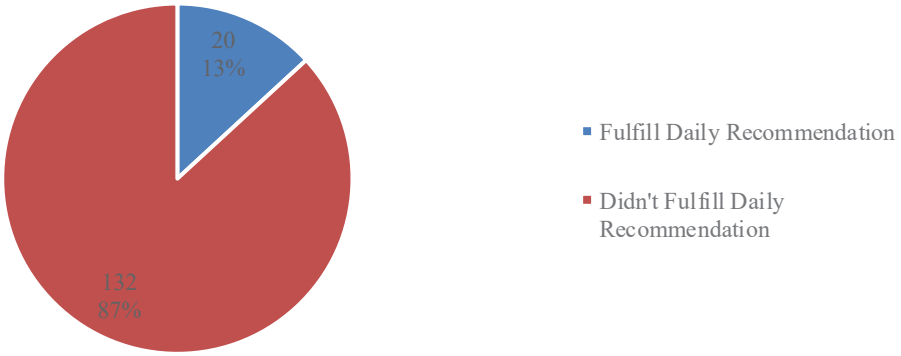

Figure 3. Classification of calcium intake variable

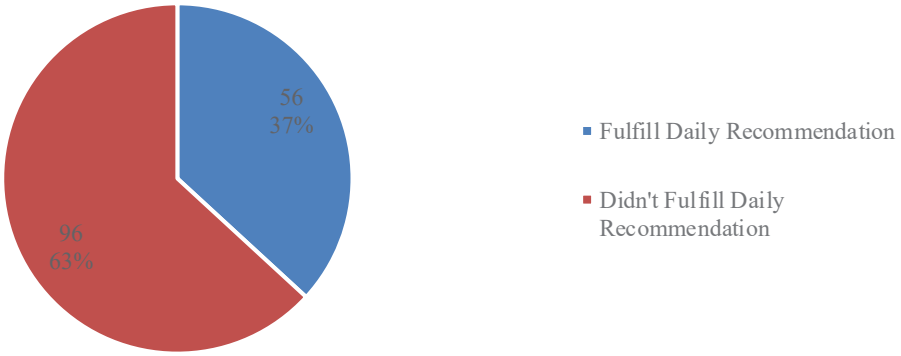

Figure 4. Classification of intensity of physical activity variable

Table 2. Results of statistical analysis between variables

Variable 1	Variable 2	Sig. (P value)	r value
Body Height	Mid-Parental Height	0.000	0.356
	Calcium Intake	0.042	-0.165
	The intensity of Physical Activity	0.278	0.089

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

In the "mid-parental height" variable, 19 students or 13% of the total sample, was classified as having "very short" MPH. 57 students or 37% of the students have "short"

In the "calcium intake" variable, 20 students or 13% of the total sample was fulfilled daily requirement of calcium, which is 1200 mg/day. While 132 students or 87% of the total sample was not fulfill daily recommendation of calcium intake. The result was also shown in Figure 3.

In the "intensity of physical activity" variable, 56 students, or 37% of total sample, have fulfilled daily recommendations for daily physical activity, which is 240 MET/day. In comparison, 96 students, or 63% of the total sample, didn't fulfill the daily recommendation. The result is also shown in Figure 4.

The results of the statistical analysis between variables are shown in table 2. Statistical analysis between the student's body height and mid-parental height results in P value of 0.000 and an r value of 0.356. This means that the student's height was significantly related ($p<0.05$) to mid-parental height with moderate strength. While analysis between calcium intake and student's body height results in P value of 0.042 and r value of -0.165, this means that calcium intake has significant relation ($p<0.05$) to the body height, but because the strength is too weak, it was considered to have no correlation. And the analysis of the intensity of physical activity with student's body height results in a P value of 0.278 with an r-value of 0.089. This means that the intensity of physical activity was not related to the body height of the students.

DISCUSSION

The result of the statistical analysis means that mid-parental height was positively related to the growth of body height; this result was similar to previous research (Goyal et al., 2020). This relation might happen because parents inherit genes from their offspring; research has found that no less than 180 genes are related to body height growth (Lango Allen et al., 2010). These genes were also found to regulate biological pathways that have big roles in body height growth such as Hedgehog Signaling Pathway, which regulated by BMP2 and BMP6 (Yang et al., 2015), MAPK signaling pathway, which regulated by FGFR4 and GNA12, TGFb signaling pathway, which regulated by GDF5 and ID4 (Guasto & Cormier-Daire, 2021), and Endothelin signaling pathway, which regulated by PRKG2 (Kristianto et al., 2017).

Statistical analysis of calcium intake and body height growth showed no relationship between calcium intake and body height growth. Previous researches have various results regarding this matter; some research found that increased calcium supplementation could support body height growth. One of those researches found that consuming calcium below a specific cutoff value could affect final body height, while increasing calcium intake above the cutoff value didn't increase final body height but increased the body height's growth rate. Some researchers also found that calcium intake didn't correlate with body height (Maharsari, 2018; Winzenberg et al., 2007; Xu et al., 2021). This could happen because calcium has 40-60% absorption rate depending on some factors, like the concentration of calcium ions in the gastrointestinal (GIT) lumen, absorption time of the food in the GIT, and substances that could inhibit calcium absorption, such as phytate and oxalate (Shkembi & Huppertz, 2022).

The result of statistical analysis between body height growth and intensity of physical activity means that there was no relation between the two variables; previous research also found similar results (Jazbinšek & Kotnik, 2020; Kohl et al., 2013; Savitri et al., 2021). This might happen because every person has a difference in responding the physical activity, which

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

is the production of hormones and growth factors. The research found that the difference in testosterone concentration in blood before and after the exercise was related to body height, while the intensity of the activity itself was not associated with body height (Kowal et al., 2021).

The result of this research, in general, founds that calcium intake and intensity of physical activity didn't have a correlation with the growth of body height. This might be happened because of the genetic factor that limits the maximum height that could be attained (Perkins et al., 2016). Environmental factors, including calcium intake and intensity of physical activity, support optimum growth.

The limitation of this research was the data collection method, a questionnaire. This method depends on the respondents' memory, which could result in biased data. Another limitation was that this research didn't consider other factors that could affect the calcium absorption rate. To give better understand the relationship of calcium intake and the intensity of physical activity with body height growth, the next research could use cohort method with periodic evaluation from childhood through adolescence, and adulthood to monitor the exact amount of calcium which consumed and the intensity of physical activity of the research samples.

CONCLUSION

Based on the results of this research, among factors that were analyzed, mid-parental height was the only variable that correlated with the growth of student's body height, while calcium intake and intensity of physical activity was not related to the growth of student's body height. The next research could investigate other growth parameters along with the factors that could affect them.

REFERENCES

Bajer, B., Vlcek, M., Galusova, A., Imrich, R., & Penesova, A. (2015). Exercise associated hormonal signals as powerful determinants of an effective fat mass loss. *Endocrine Regulations*, *49*(3), 151–163. https://doi.org/10.4149/endo_2015_03_151

Garza, C., Borghi, E., Onyango, A. W., & De Onis, M. (2013). Parental height and child growth from birth to 2 years in the WHO multicentre growth reference study. *Maternal and Child Nutrition*, *9*(S2), 58–68. https://doi.org/10.1111/mcn.12085

Gat-Yablonski, G., & Phillip, M. (2015). Nutritionally-induced catch-up growth. *Nutrients*, *7*(1), 517–551. https://doi.org/10.3390/nu7010517

Goyal, A., Jyotsna, V. P., Singh, A. K. C., Gupta, Y., & Khadgawat, R. (2020). Etiology and Clinical Profile of Patients with Tall Stature: A Single-Center Experience. *Indian Journal of Endocrinology and Metabolism*, *24*(5). https://journals.lww.com/indjem/Fulltext/2020/24050/Etiology_and_Clinical_Profile_of_Patients_with.10.aspx

Guasto, A., & Cormier-Daire, V. (2021). Signaling Pathways in Bone Development and Their Related Skeletal Dysplasia. In *International Journal of Molecular Sciences* (Vol. 22, Issue 9). https://doi.org/10.3390/ijms22094321

Guyton, A. C., & Hall, J. E. (2019). *Guyton Dan Hall: Buku Ajar Fisiologi Kedokteran*.

IDAI. (2017). Panduan Praktik Klinis Ikatan Dokter Anak Indonesia: Perawakan Pendek pada Anak dan Remaja di Indonesia. *Ikatan Dokter Anak Indonesia*, 1–4.

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Jazbinšek, S., & Kotnik, P. (2020). Influence of physical activity on linear growth in children and adolescents. *Annales Kinesiologiae*, 29–42. https://doi.org/10.35469/ak.2020.222

Kohl, H. W., Cook, H. D., Van Dusen, D. P., Kelder, S. H., Kohl, H. W., Ranjit, N., & Perry, C. L. (2013). Educating the study body: taking physical activity and physical education to school. Chapter 4: Physical Activity, Fitness, and Physical Education: Effects on Academic Performance. In *Journal of School Health* (Vol. 81, Issue 12).

Kowal, M., Sorokowski, P., Żelaźniewicz, A., Nowak, J., Orzechowski, S., Żurek, A., & Żurek, G. (2021). A positive relationship between body height and the testosterone response to physical exercise. *Evolution and Human Behavior*, *42*(3), 179–185. https://doi.org/https://doi.org/10.1016/j.evolhumbehav.2020.08.012

Kristianto, J., Johnson, M. G., Afzal, R., & Blank, R. D. (2017). Endothelin Signaling in Bone. *Endocrinology and Metabolism Clinics of North America*, *46*(1), 51–62. https://doi.org/10.1016/j.ecl.2016.09.014

Lango Allen, H., Estrada, K., Lettre, G., Berndt, S. I., Weedon, M. N., Rivadeneira, F., Willer, C. J., Jackson, A. U., Vedantam, S., Raychaudhuri, S., Ferreira, T., Wood, A. R., Weyant, R. J., Segrè, A. V, Speliotes, E. K., Wheeler, E., Soranzo, N., Park, J.-H., Yang, J., … Hirschhorn, J. N. (2010). Hundreds of variants clustered in genomic loci and biological pathways affect human height. *Nature*, *467*(7317), 832–838. https://doi.org/10.1038/nature09410

Maharsari, D. R. (2018). *HUBUNGAN ASUPAN KALSIUM DENGAN TINGGI BADAN REMAJA SMP MUHAMMADIYAH 2 SURAKARTA*.

Perkins, J. M., Subramanian, S. V., Smith, G. D., & Özaltin, E. (2016). Adult height, nutrition, and population health. *Nutrition Reviews*, *74*(3), 149–165. https://doi.org/10.1093/nutrit/nuv105

Riskesdas Jatim. (2018). Laporan Provinsi Jawa Timur RISKESDAS 2018. In *Kementerian Kesehatan RI*. https://drive.google.com/drive/folders/1XYHFQuKucZIwmCADX5ff1aDhfJgqzI-l%0A

Savitri, A., Zulhamidah, Y., & Widayanti, E. (2021). Hubungan Aktivitas Fisik terhadap Tinggi Badan pada Mahasiswa Fakultas Kedokteran Umum Universitas YARSI yang Berumur Kurang dari atau Sama dengan 20 Tahun. *Majalah Kesehatan Pharmamedika*, *12*. https://doi.org/10.33476/mkp.v12i1.1603

Sherwood, L. (2016). *Human physiology : from cells to systems / by Lauralee Sherwood* (9th ed.).

Shkembi, B., & Huppertz, T. (2022). Calcium Absorption from Food Products: Food Matrix Effects. In *Nutrients* (Vol. 14, Issue 1). https://doi.org/10.3390/nu14010180

Winzenberg, T., Shaw, K., Fryer, J., & Jones, G. (2007). Calcium Supplements in Healthy Children Do Not Affect Weight Gain, Height, or Body Composition. *Obesity*, *15*(7), 1789–1798. https://doi.org/https://doi.org/10.1038/oby.2007.213

Xu, B., Feng, Y., Gan, L., Zhang, Y., Jiang, W., Feng, J., & Yu, L. (2021). Vitamin D Status in Children With Short Stature: Accurate Determination of Serum Vitamin D Components Using High-Performance Liquid Chromatography-Tandem Mass Spectrometry. *Frontiers in Endocrinology*, *12*, 707283. https://doi.org/10.3389/fendo.2021.707283

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Yang, J., Andre, P., Ye, L., & Yang, Y.-Z. (2015). The Hedgehog signalling pathway in bone formation. *International Journal of Oral Science*, *7*(2), 73–79. https://doi.org/10.1038/ijos.2015.14