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RESEARCH ARTICLE

The Role of Lumbar CT Scan Anthropometric Parameters to Predict the Height of Indonesian Adults

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Abstract

Anthropometry, the study of human body measurements, is crucial in estimating stature, which is valuable in medical research, forensic science, anthropology, and ergonomic design. While various methods exist for estimating stature, lumbar spine measurements make a significant contribution to this estimation. This study aimed to analyze the relationship between lumbar spine dimensions and stature in the Indonesian population using three-dimensional computed tomography (3D CT) scan data. This analytical observational study, employing a cross-sectional approach, was conducted at the Department of Radiology, Dr. Soetomo General Academic Hospital, Surabaya, from August to September 2023. The key measurements included heights of the posterior, anterior, and central vertebral bodies from lumbar 1 to lumbar 5 (L1 to L5), transverse pedicle diameter, pedicle axis length, vertical pedicle diameter, and overall stature. The study included 66 subjects (30 males and 36 females). Males had an average height of 165.86 cm, while females had an average height of 155.85 cm. Significant gender differences were observed in heights of the posterior vertebral body (HPVB), heights of the central vertebral body (HCVB), and pedicle axis length (PAL) measurements. HPVB of L1 can be used as a predictor of height in females ($p<0.001$), whereas PAL of L5 can be used as a predictor of height in males ($p=0.006$). Lumbar spine dimensions measured using 3D CT scans provide reliable stature predictions, with specific measurements such as HPVB from L1 in females and PAL from L5 in males showing high accuracy. These findings support the development of population-specific anthropometric tools and enhance understanding of factors influencing stature in Indonesia.

Keywords: BMD-DXA, CKD, osteoporosis, panoramic radiography, T-score

Introduction

Anthropometry, the scientific study of human body measurements and proportions, is crucial for various fields, including medical research, forensic science, anthropology, and ergonomic design.[1] A critical aspect of anthropometric research is the estimation of stature, which provides valuable information for diagnosing and treating growth-related conditions like growth disorders, osteoporosis, or scoliosis in the medical field.[2] In forensic science, stature estimation aids in identifying victims or suspects based on physical remains at crime scenes.[3] Anthropologists use stature estimation to gain insights into physical variations among populations and human evolution.[4] Additionally, understanding body dimensions is crucial in ergonomic design to develop equipment, furniture, and environments tailored to individual body sizes, enhancing comfort and efficiency.[5]

Although anthropometric research has been widely conducted globally, each population exhibits unique physical characteristics influenced by genetic, environmental, and cultural factors.[4] In Indonesia, however, there is a lack of specific anthropometric data and standardized measurement tools, which can hinder progress in fields that rely on accurate body dimension and stature data.

Stature estimation typically involves measuring body dimensions closely related to height, such as limb length, femur length, and spinal length.[6] The lumbar spine, comprising five vertebrae, is pivotal in determining height and providing stability to the vertebral column, supporting various physical activities.[4,7] Therefore, the dimensions of the lumbar spine

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can offer valuable clues about an individual's stature.

Previous studies on anthropometric measurements of the human spine have utilized different methods. Traditional approaches employed instruments like calipers, whereas recent studies have adopted radiological procedures, such as MRI, CT scans, and lateral vertebral cephalograms, for stature estimation.[8] Several examination modalities can be used to measure lumbar spine dimensions, including bone densitometry, posture examination, traditional anthropometric measurements, and three-dimensional computed tomography (3D CT) scans. Among these, 3D CT scans are the most advanced, providing accurate and detailed information about spinal structures.[9,10] In addition to predicting height, CT scans have also been shown to be effective in determining sex using pelvic CT scans.[11,12]

This study investigates the research question: can anthropometric measurements of the lumbar spine, derived from 3D CT scans, accurately predict individual height in the Indonesian population? Its novelty stems from being the first to employ 3D CT scans to examine lumbar spine anthropometrics for height prediction in Indonesians, a population that may possess unique anatomical features. Prior studies have explored lumbar vertebrae measurements for stature estimation in other populations. For instance, Klein et al.[3] estimated stature using a virtual CT model of lumbar vertebrae L2 to L5 from Caucasian male cadavers, finding that the central height of vertebra L2 provided the best prediction results. Similarly, Zhang et al.[4] conducted a study on healthy volunteers in China, where the posterior height of the L3 vertebral body provided the most accurate results for the total male group.

In contrast, the central height of the L1 vertebral body was most accurate for the total female group and women over 45. The central height of the L3 vertebral body was most accurate for individuals aged 20 to 45, regardless of sex, and for men over 45.[3,4] This study aimed to analyze the relationship between lumbar spine dimensions and stature in the Indonesian population using 3D CT scan data.

Methods

This study is an analytical observational research with a cross-sectional approach conducted at the Department of Radiology, Integrated Diagnostic Center, Dr. Soetomo General Academic Hospital, Surabaya, from August 2023 to September 2023. The study population consisted of all patients undergoing 3D CT lumbar examinations at the Radiology Installation of Dr. Soetomo General Academic Hospital during the specified period. Consecutive sampling was employed to collect data from 3D CT lumbar vertebrae scans performed between August 2023 and September 2023, adhering to strict inclusion and exclusion criteria.

The inclusion criteria for the study were male and female patients aged 18 to 50 years who had undergone 3D CT scans of the lumbar vertebrae and abdominal CT scans at the Radiology Installation of Dr. Soetomo General Academic Hospital. Additionally, female patients included in the study were not pregnant. Exclusion criteria comprised patients with 3D CT lumbar images showing features that could interfere with accurate measurements, such as fractures, listhesis, tumors, and degenerative changes. Based on the sample size calculation, the study required a minimum of 54 patients.

The research utilized digital data obtained from the 3D CT scan results of the lumbar spine. The Philips MRC 880 128-slice CT scanner, located at the Radiology Installation of Dr. Soetomo General Academic Hospital, was used for imaging. Patient demographic data were retrieved from medical records. The primary variables studied included the heights of the posterior, anterior, and central vertebral bodies from lumbar 1 to lumbar 5 (L1 to L5), transverse pedicle diameter, pedicle axis length, vertical pedicle diameter, and overall stature measured from the soles of the feet to the top of the head in a standing position on a flat surface.

Patients selected for the research were chosen using consecutive sampling. The 3D CT scan of the lumbar vertebrae was conducted using a volume rendering technique with the Philips MRC 880 128-slice CT scanner. The scanned images were processed using a computer workstation connected to the Philips MRC 880

CT scanner. All documentation was recorded in a digital format, specifically using digital imaging and communications in medicine (DICOM) standards, to ensure consistent and accurate data collection. To maintain patient confidentiality, all collected data were anonymized by the research protocols established at Dr. Soetomo General Academic Hospital. The study has been approved by the Health Research Ethics Committee of Dr. Soetomo General Academic Hospital, Surabaya, with registration number 1470/LOE/30.14.2/IX/2023 for ethical clearance. The relevant guidelines and regulations were followed during all procedures.

Data cleaning, coding, and tabulation were performed before being entered into a computer system. The statistical analysis was carried out using SPSS version 25, which included descriptive analysis, normality testing, and t-test for comparing between sex groups if the data follows a normal distribution; otherwise, the Mann-Whitney test was used, and Pearson's correlation test if the data follows a normal distribution; otherwise, Spearman's rank test was used. The data were further analyzed using linear regression modeling to determine the relationship between lumbar spine dimensions and stature in the Indonesian population.

Results

Table 1 presents the characteristics of the research subjects, comprising 66 individuals, of whom 30 are male and 36 are female. The overall average age of the subjects was 38.18 years.

Table 2 presents the anthropometric data of lumbar vertebrae measured using CT scans on research subjects. Heights of posterior vertebral body (HPVB) measurements from L1 to L5 consistently showed higher average values in males compared to females, with significant differences ($p<0.05$). Heights of central vertebral body (HCVB) measurements also showed higher average values in males compared to females, with substantial differences at L1, L2, and L3 ($p<0.05$). Transverse pedicle diameter (TPD) and vertical pedicle diameter (VPD) measurements were generally higher in males, with VPD showing substantial differences in all lumbar vertebrae except L5. Pedicle axis length (PAL) measurements consistently showed higher average values in males across all lumbar vertebrae with significant differences ($p<0.05$). These findings indicate substantial differences in several anthropometric measurements of lumbar vertebrae between males and females.

Table 3 presents the correlation analysis using Pearson's correlation test between anthropometric measurements of lumbar vertebrae and height in male and female groups. In males, the correlation between lumbar vertebrae measurements and height generally showed a weak relationship, with most r values below 0.3. Exceptions were observed in VPD.L1 and PAL (specifically PAL.L1, PAL.L3, and PAL.L5), where r values indicated moderate correlation and p values demonstrated statistical significance. In females, several measurements showed more substantial correlations with height, particularly HPVB.L1, HCVB.L1, HCVB.L2, and HCVB.L3, as well as some HAVB and PAL measurements. HPVB.L1 stood out with a relatively high r-value (0.604) and a highly significant p-value (<0.001). These results show variations in the relationship between lumbar vertebrae measurements and height between males and females.

Table 4 shows the linear regression equation of each lumbar vertebrae anthropometric component against height. For males, most linear regression equations showed statistically insignificant relationships with height. However, there were exceptions such as VPD.L1, which showed a significant relationship with height ($Y=134.18+22.34X$, $p=0.018$), and some PAL

Table 1 Characteristics of Research Subjects

Characteristics	Male (n=30) Mean (SD)	Female (n=36) Mean (SD)	Total (n=66) Mean (SD)
Age (years)	39.53 (8.56)	37.06 (9.2)	38.18 (8.93)
Height (cm)	165.86 (6.6)	155.85 (5.16)	160.4 (7.68)

Table 2 Lumbar Vertebrae Anthropometric Data

Anthropometric Measurements	Male (n=30) Mean (SD)	Female (n=36) Mean (SD)	p*
Heights of posterior vertebral body (cm)			
L1	2.58 (0.15)	2.41 (0.16)	<0.001
L2	2.63 (0.16)	2.5 (0.16)	0.003
L3	2.59 (0.15)	2.49 (0.16)	0.01
L4	2.5 (0.17)	2.39 (0.19)	0.017
L5	2.43 (0.17)	2.33 (0.17)	0.027
Heights of central vertebral body (cm)			
L1	2.38 (0.17)	2.26 (0.14)	0.002
L2	2.43 (0.16)	2.34 (0.14)	0.021
L3	2.42 (0.19)	2.36 (0.14)	0.159
L4	2.36 (0.19)	2.31 (0.13)	0.229
L5	2.35 (0.2)	2.3 (0.16)	0.191
Heights of anterior vertebral body (cm)			
L1	2.4 (0.16)	2.33 (0.15)	0.101
L2	2.53 (0.17)	2.5 (0.16)	0.374
L3	2.56 (0.18)	2.57 (0.19)	0.813
L4	2.49 (0.21)	2.51 (0.17)	0.794
L5	2.56 (0.18)	2.54 (0.2)	0.76
Transverse pedicle diameter (cm)			
L1	0.57 (0.12)	0.52 (0.11)	0.076
L2	0.64 (0.14)	0.57 (0.11)	0.042
L3	0.76 (0.11)	0.7 (0.13)	0.06
L4	0.95 (0.15)	0.87 (0.12)	0.03
L5	1.31 (0.2)	1.27 (0.15)	0.363
Vertical pedicle diameter (cm)			
L1	1.42 (0.13)	1.31 (0.12)	0.001
L2	1.35 (0.12)	1.25 (0.11)	0.001
L3	1.32 (0.11)	1.23 (0.1)	0.002
L4	1.25 (0.11)	1.17 (0.09)	0.001
L5	1.24 (0.12)	1.2 (0.12)	0.111
Pedicle axis length (cm)			
L1	4.55 (0.25)	4.28 (0.19)	<0.001
L2	4.59 (0.34)	4.32 (0.39)	0.002
L3	4.59 (0.23)	4.37 (0.27)	0.001
L4	4.53 (0.27)	4.27 (0.2)	<0.001
L5	4.48 (0.2)	4.29 (0.25)	0.001

Note: *independent t-test, significance p<0.05

measurements, specifically PAL.L1, PAL.L3, and PAL.L5, which also showed significant relationships. For females, the relationship between lumbar vertebrae measurements and height appeared more substantial and more critical for several parameters. HPVB.L1 stood out with a very significant relationship (Y=109.55+19.18X, p<0.001), as did some HCVB and HAVB measurements. The best accuracy for predicting male height was with PAL.L5, which had an accuracy of ±5.87 cm, whereas for females, it was HPVB.L1 with an accuracy of ±4.17 cm.

Table 5 presents the linear regression equations that integrate all components of lumbar vertebrae anthropometric measurements for each lumbar vertebra to predict height for both males and females. For males, the equation for L5 showed the strongest statistical significance (p=0.007), with a diverse combination of factors influencing height. For females, the equation for L1 revealed

Table 3 Correlation of Lumbar Vertebrae Anthropometry with Height

Anthropometric Measurements	Male (n=30)		Female (n=36)	
	r	p*	r	p*
Heights of posterior vertebral body				
L1	0.162	0.393	0.604	<0.001
L2	0.274	0.143	0.315	0.061
L3	0.125	0.509	0.416	0.012
L4	0.198	0.295	0.433	0.008
L5	0.291	0.118	0.358	0.032
Heights of central vertebral body				
L1	0.208	0.27	0.52	0.001
L2	0.149	0.433	0.49	0.002
L3	0.135	0.479	0.46	0.005
L4	0.198	0.295	0.504	0.002
L5	0.114	0.549	0.43	0.009
Heights of anterior vertebral body				
L1	0.187	0.323	0.415	0.012
L2	0.105	0.581	0.363	0.03
L3	0.289	0.121	0.382	0.022
L4	0.22	0.242	0.536	0.001
L5	0.018	0.926	0.346	0.038
Transverse pedicle diameter				
L1	0.032	0.868	0.009	0.959
L2	0.343	0.063	0.133	0.44
L3	0.141	0.458	0.188	0.272
L4	0.332	0.073	0.112	0.516
L5	0.367	0.046	0.149	0.386
Vertical pedicle diameter				
L1	0.429	0.018	0.046	0.79
L2	0.017	0.928	0.071	0.681
L3	0.162	0.392	0.141	0.414
L4	−0.272	0.147	0.064	0.712
L5	−0.094	0.622	0.333	0.047
Pedicle axis length				
L1	0.415	0.023	0.397	0.016
L2	0.248	0.186	0.07	0.686
L3	0.441	0.015	0.471	0.004
L4	0.388	0.034	−0.013	0.939
L5	0.486	0.006	0.246	0.148

Note: *Pearson's correlation test, significance p<0.05

a highly significant relationship (p=0.011), with a substantial positive contribution from HPVB and HCVB. The accuracy of the linear regression equations per lumbar vertebrae ranged from ±5.2 cm to ±6.42 cm for males and from ±4.32 cm to ±4.89 cm for females.

Table 6 presents the linear regression equations for the combination of lumbar vertebrae anthropometric components that provided the most reliable results in predicting height for male and female groups. For males, the reliability, measured through the correlation coefficient (r), showed that L5 had the strongest correlation (r=0.714) and the highest statistical significance (p=0.007). For females, the equation for L1 showed a very strong correlation (r=0.646) with high significance (p=0.011). The most reliable linear regression equation per lumbar

Table 4 Linear Regression Equation of Each Lumbar Vertebrae Anthropometric Component Against Height

Anthropometric Measurements	Male (n=30)			Female (n=36)		
	Equation	SE	p	Equation	SE	p
HPVB						
L1	Y=148.07+6.91X	6.63	0.394	Y=109.55+19.18X	4.17	<0.001
L2	Y=136.6+11.15X	6.46	0.144	Y=129.89+10.37X	4.97	0.062
L3	Y=151.76+5.45X	6.67	0.509	Y=123.11+13.17X	4.76	0.011
L4	Y=146.3+7.83X	6.59	0.294	Y=127.06+12.05X	4.72	0.008
L5	Y=139.06+11.05X	6.43	0.119	Y=130.06+11.07X	4.89	0.032
HCVB						
L1	Y=146.72+8.03X	6.58	0.269	Y=111.28+19.71X	4.47	0.001
L2	Y=150.95+6.13X	6.65	0.433	Y=114.76+17.58X	4.56	0.002
L3	Y=154.49+4.7X	6.66	0.478	Y=116.03+16.85X	4.65	0.005
L4	Y=149.59+6.89X	6.59	0.295	Y=109.86+19.9X	4.52	0.002
L5	Y=157+3.76X	6.68	0.549	Y=124.08+13.84X	4.72	0.009
HAVB						
L1	Y=147.7+7.58X	6.6	0.323	Y=123.02+14.08X	4.76	0.012
L2	Y=155.6+4.05X	6.68	0.581	Y=125.98+11.96X	4.88	0.029
L3	Y=139.34+10.36X	6.43	0.121	Y=129.63+10.2X	4.84	0.022
L4	Y=148.39+7X	6.56	0.242	Y=114.01+16.7X	4.42	0.001
L5	Y=164.19+0.66X	6.72	0.927	Y=132.83+9.04X	4.91	0.038
TPD						
L1	Y=164.9+1.7X	6.72	0.869	Y= 155.64 + 0.41X	5.23	0.961
L2	Y=155.72+15.91X	6.31	0.063	Y= 152.35 + 6.11X	5.19	0.441
L3	Y=159.36+8.58X	6.65	0.456	Y= 150.56 + 7.56X	5.14	0.273
L4	Y=151.87+14.78X	6.34	0.074	Y= 151.69 + 4.76X	5.2	0.515
L5	Y=149.99+12.14X	6.25	0.046	Y= 149.34 + 5.13X	5.18	0.385
VPD						
L1	Y=134.18+22.34X	6.07	0.018	Y=153.34+1.91X	5.23	0.791
L2	Y=164.65+0.9X	6.72	0.93	Y=151.75+3.27X	5.22	0.682
L3	Y=153.12+9.67X	6.63	0.392	Y=147.21+7X	5.18	0.413
L4	Y=185.73−15.88X	6.47	0.147	Y=151.46+3.77X	5.22	0.712
L5	Y=172.47−5.32X	6.69	0.621	Y=138.59+14.44X	4.94	0.047
PAL						
L1	Y=115.67+11.03X	6.12	0.023	Y=109.67+ 10.8X	4.8	0.016
L2	Y=143.45+4.88X	6.51	0.186	Y=151.81+0.94X	5.22	0.686
L3	Y=107.3+12.75X	6.03	0.015	Y=116.77+8.95X	4.62	0.004
L4	Y=122.22+9.63X	6.2	0.034	Y=157.22−0.32X	5.23	0.941
L5	Y=93.04+16.24X	5.87	0.006	Y=133.89+5.12X	5.07	0.148

Note: HPVB: heights of posterior vertebral body; HCVB: heights of central vertebral body; HAVB: heights of the anterior vertebral body; TPD: transverse pedicle diameter; VPD: vertical pedicle diameter; PAL: pedicle axis length

vertebrae had an accuracy ranging from ±5.2 cm to ±6.07 cm for males and from ±4.32 cm to ±4.68 cm for females.

Discussion

This study evaluated the use of radiological anthropometry to estimate height, specifically in the Indonesian population, by measuring the dimensions of the lumbar vertebrae. The demographic characteristics of the research subjects showed an average age of 38.18 years, with significant variations in height between males and females. Significant differences were also found between males and females in the measurements of HPVB, HCVB, and PAL from L1

Table 5 Combined Linear Regression Equation of Each Lumbar Vertebrae Against Height

Lumbar Vertebrae	Male (n=30)			Female (n=36)		
	Equation	SE	p	Equation	SE	p
L1	TB=68.32−5.02 HPVB−5.24 HCVB+21.51 HAVB−4.8 TPD+24.07 VPD+8.79 PAL	5.82	0.061	TB=96.18+15.99 HPVB+8.68 HCVB−5.64 HAVB −4.64 TPD−1.9 VPD+4.55 PAL	4.32	0.011
L2	TB=108.31+12.89 HPVB −1.34 HCVB−0.28 HAVB+17.66 TPD+2.01 VPD+2.99 PAL	6.42	0.306	TB=113.83−9.29 HPVB +26.34 HCVB+0.54 HAVB−0.18 TPD+4.27 VPD−0.67 PAL	4.81	0.12
L3	TB=102.24−18.87 HPVB+7.37 HCVB+13.29 HAVB+1.4 TPD+8.54VPD+10.53 PAL	6.34	0.255	TB=93.7+0.35 HPVB+6.96 HCVB+4.47 HAVB +3.14 TPD+1.93 VPD+6.59 PAL	4.61	0.047
L4	TB=121.62+1.5 HPVB−2.3 HCVB+4.03 HAVB+13.42 TPD−14.97 VPD+9.25 PAL	6.04	0.117	TB=111.41−1.25 HPVB +11.05 HCVB+11.74 HAVB+4.42 TPD−1.28 VPD−2.32 PAL	4.62	0.05
L5	TB=112.83+38.3 HPVB−6.89 HCVB−21.39 HAVB +7.5 TPD−16.98 VPD+9.45 PAL	5.2	0.007	TB=105.61+1.7 HPVB+8.97 HCVB+0.91 HAVB +2.57 TPD+8.43 VPD+2.34 PAL	4.89	0.167

to L5, with males generally having higher values. These results suggest that anatomical differences based on gender have a significant influence on height prediction using anthropometric approaches. It is consistent with previous studies that differentiate height prediction formulas based on gender.[4]

Anthropometric measurements of the lumbar vertebrae have proven to be effective for estimating height.[8] This study found that the PAL of L5 was the most accurate single measurement for predicting height in males. In contrast, HPVB of L1 provided the most accurate height estimates in females. Previous research in Türkiye on males and females indicated that PAL significantly correlates with age and height. The highest PAL values in that study were found in the 30–39 age group, and taller individuals tended to have higher PAL values.[13] A study in China showed different results from this study, with HPVB L3 being the most accurate for males, HCVB L1 for females, and HCVB L3 providing the most accurate results for both genders.[4]

The study demonstrated that anthropometric measurements of L5 provided the most accurate height predictions in males, while L1 measurements were most accurate in females. Different findings were reported in the Iranian population, where most L2 and L3 parameters showed positive correlations with height in both males and females.[14] A study on Italian women using morphometric x-ray absorptiometry (MXA), a derivative of dual-energy x-ray absorptiometry (DEXA), excluded L5 due to anatomical overlap inaccuracies in DEXA images.[15] Previous cadaver studies in the United States using digital calipers to measure pedicle dimensions from L1 to L5 showed significant relationships between pedicle dimensions and body size, with taller and heavier individuals having larger pedicles. Gender differences were also noted, with males having larger pedicles across all lumbar vertebrae compared to females, although no significant correlation was found between pedicle dimensions and age or race.[16] Research in the Finnish population estimated height using only the fourth lumbar vertebra (L4), with MRI scans indicating that the average width, depth, and height of L4 were good predictors of height, with an overall prediction accuracy of

Table 6 The Most Reliable Linear Regression Equation of Each Lumbar Vertebrae Against Height

Lumbar Vertebrae	Male (n=30)				Female (n=36)			
	Equation	SE	r	p	Equation	SE	r	p
L1	TB=70.58−7.03 HPVB+18.3 HAVB−3.62 TPD +23.24 VPD+ 8.49 PAL	5.72	0.616	0.033	TB=96.18+15.99 HPVB+8.68 HCVB−5.64 HAVB−4.64 TPD −1.9 VPD+4.55 PAL	4.32	0.646	0.011
L2	TB=118.29+ 13.67 HPVB+ 18.34 TPD	6.02	0.477	0.031	TB=114.03−9.08 HPVB+26.6 HCVB+4.24 VPD −0.68 PAL	4.65	0.528	0.033
L3	TB=100.7+5.38 HAVB+11.2 PAL	6.07	0.463	0.039	TB=93.7+0.35 HPVB+6.96 HCV +4.47 HAVB+ 3.14 TPD+1.93 VPD+6.59 PAL	4.61	0.582	0.047
L4	TB=122.12+3.46 HAVB+12.88 TPD−15.22 VPD +9.26 PAL	5.8	0.578	0.032	TB=109.94−1.22 HPVB+11.74 HCVB+11.85 HAVB+4.33 TPD −2.22 PAL	4.55	0.578	0.025
L5	TB=112.83+38.3 HPVB−6.89 HCVB−21.39 HAVB+7.5 TPD− 16.98 VPD+9.45 PAL	5.2	0.714	0.007	TB=109.22+11.9 HCVB+8.14 VPD +2.24 PAL	4.68	0.498	0.026

±5.635 cm.[6]

This study further emphasizes the importance of considering population-specific anatomical differences when using radiological anthropometry for height estimation.[17] Variations in vertebral dimensions across different populations underline the need for tailored approaches to improve prediction accuracy.[18] For instance, the reliance on different lumbar vertebrae measurements to predict height across populations highlights the necessity for region-specific data and methodologies to ensure accurate assessments.[19] Moreover, the role of advanced imaging techniques like MRI and DEXA in enhancing the precision of these measurements cannot be understated.[20] This reinforces the need for continuous advancements in imaging technology and methodology to overcome these challenges and provide more reliable data for anthropometric studies.[21]

This study has limitations that may affect the interpretation and application of its findings. The sample was limited to adults from a single center, which may not capture the anatomical variability of lumbar vertebrae across the Indonesian population. While CT scans provided detailed images of lumbar morphology, the sample size and age distribution were restricted. Additionally, the study did not account for factors such as genetics, bone health history, medical conditions affecting bone structure, physical activity, or nutrition, which could influence the dimensions of the lumbar vertebrae.

Conclusions

Lumbar spine dimensions measured using 3D CT scans provide reliable stature predictions, with specific measurements such as HPVB from L1 in females and PAL from L5 in males. These findings support the development of population-specific anthropometric tools and enhance understanding of factors influencing stature in Indonesia.

Conflict of Interest

The authors have no conflicts of interest to declare.

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