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Original Article

Physiotherapy Section

Effect of Body Height on Aerobic Capacity of Young Adults: A Cross-sectional Study

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ABSTRACT

Introduction: Maximal oxygen consumption (VO_2 max) is a vital component of overall fitness and a direct predictor of the risk of cardiovascular and metabolic diseases. Body height, as a part of body composition, can affect the body's overall physiology. However, limited literature has documented the relationship between body height and maximal oxygen consumption.

Aim: To determine the effect of body height on the aerobic capacity of young adults using the multistage 20 m shuttle run test.

Materials and Methods: A cross-sectional study was conducted at the Department of Cardio-Respiratory Physiotherapy, College of Physiotherapy, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India, from July 2020 to May 2021. A total of 106 participants were included in the study and categorised into short, medium and tall-height groups. They performed the Multistage 20 m Shuttle Run test, which involved a pre-recorded audio signal. Participants were motivated to pace themselves with the audio signals until their exhaustion level. VO_2 max was calculated using the equation that incorporates maximal aerobic speed. Chi-square tests and independent sample t-tests were performed to find the associations between different categorical variables. One-way Analysis of Variance (ANOVA) and post-hoc analyses were applied to determine intergroup significance among the three groups. The level of significance (p-value) was set at <0.05.

Results: There was no significant difference in maximal oxygen consumption among the three groups (p-value=0.930). However, a statistically significant difference was found in VO_2 max between males and females (p-value=0.003).

Conclusion: The present study concludes that height does not affect maximal oxygen consumption in healthy young adults. Other factors, such as body composition, genetics, level of training and anatomical, physiological and biomechanical differences, contribute significantly to the levels of maximal oxygen consumption in adults. The commercials and unresearched data claiming that body height is an essential aspect of a healthy life can be rejected and/or questioned based on this study.

Keywords: Body composition, Genetics, Maximal oxygen consumption, Multistage 20 m Shuttle Run test

INTRODUCTION

Aerobic capacity is the ability to perform rhythmic, dynamic, continuous activities involving large muscle groups at moderate to high intensity for a sustained period [1]. It is also known as cardiorespiratory fitness or cardiorespiratory endurance and is one of the important health-related components of physical fitness [2,3].

The mortality rates associated with cardiovascular conditions such as coronary heart disease and hypertension, as well as metabolic conditions involving high lipid levels, insulin intolerance, high blood glucose levels and total body fat, are directly affected by the aerobic capacity of individuals [2]. A population with high aerobic capacity is less susceptible to all-cause mortality risks [4]. Regular participation in exercise improves aerobic capacity and higher values of aerobic capacity contribute to the overall health of an individual. Primarily, endurance training or a combination of strength and endurance training enhances quality of life and fitness [1,5,6].

The measurement of aerobic capacity is conducted either using maximal oxygen consumption or metabolic equivalent. Maximal oxygen consumption (VO_2 max) is considered the gold standard criterion for measuring aerobic capacity or cardiorespiratory fitness. Maximal oxygen consumption is defined as the highest rate of oxygen uptake that occurs during sustained maximal exercise. VO_2 max describes the highest oxygen uptake achieved when the body is performing dynamic exercises with increasing intensity. VO_2 max is an indication of the body's ability to resynthesise the energy used aerobically [1,7]. VO_2 max is measured in absolute value as L/kg/hr and in relative value as mL/kg/min (which is commonly used). Other determining factors for aerobic capacity include the level of physical activity, body composition, age, genetic makeup and any existing pathological conditions [7,8].

The most conventional method of assessing VO_2 max is through the analysis of the gases expired by an individual while performing a graded exercise test, whether maximal or submaximal [9]. The need for expensive instrumentation, along with mechanical and technical challenges, standardised software and constrained environmental settings during the test, contributes to efficient levels and the most accurate estimation of VO_2 max [10].

Various tests have been developed to assess cardiorespiratory fitness or aerobic capacity. These tests are modified according to the availability of equipment, test settings, individual requirements and other factors. These aerobic capacity evaluation tests are broadly classified into maximal and submaximal tests [7,11].

The maximal test measures an individual's aerobic capacity until volitional exhaustion. Different types of maximal tests include laboratory tests and field tests. Laboratory tests consist of the treadmill test (Bruce protocol, Balke protocol) and the cycle ergometer test (Andersen protocol, Strover-Davis protocol for males and females separately). Field tests include timed tests (5-minute run test, Cooper's 12-minute run test, Cooper's 12-minute swim test) and distance-based tests (mile run tests, 1.5-mile run tests, 2-mile run tests, marathon competitions). However, there are disadvantages to maximal tests that make them difficult to apply to a large number of people. These include: 1) they are expensive; 2) fine calibration is needed; 3) they require laboratory set-up; and 4) a technical knowledge of how to operate the equipment [2,7].

The submaximal test determines aerobic capacity based on the value of HRmax in relation to the graded exercise test. Maximal oxygen consumption is evaluated directly or indirectly using the heart rate values achieved in progressively increasing intensity exercises. Submaximal tests can also be defined as exercise tests used to assess cardiopulmonary fitness by predicting the VO_2 max of individuals based on their ability to perform a standardised task. Many individuals suffer from limitations related to cardiopulmonary, musculoskeletal and neuromuscular impairments. For this reason, submaximal tests are preferred over maximal tests. Additional advantages of submaximal tests include that they are inexpensive, readily available and can be performed without technical expertise [2,11].

Similarly, both maximal and submaximal tests have standardised protocols. They are to be conducted either within a specific time duration at a predetermined distance or a predetermined frequency. Field tests are easier to perform, require less instrumentation and are valid and reliable. One of the most widely performed submaximal field tests is the Multistage 20 m Shuttle Run test. Other names for this test include the pacer test, shuttle run test, bleep test, beep test and multistage fitness test. It is less time-consuming and can be administered to a large number of people simultaneously. Moreover, it is inexpensive and requires minimal equipment, making it suitable for people of any age group [2,11].

Various equations have been proposed by scientists and experts to evaluate maximal oxygen consumption using either maximal or submaximal graded exercise tests. These equations provide an indirect estimation of VO_2 max using a combination of parameters, including age, gender, height, BMI, speed of the test, weight and the total number of laps completed during the test [3,12].

Body height is an important parameter in relation to various anthropometric values. It is an unmodifiable factor. Genetics, skeletal maturation, nutrition and congenital or acquired diseases in childhood play a significant role in determining an individual's body height. Height differences can be notably observed across different regions. Physiologically, varying heights are responsible for different factors such as stroke volume, cardiac output and pulmonary ventilation. Body height is also a crucial factor in controlling BMI, which directly measures the risk of cardiovascular and metabolic diseases [2].

Tall height is associated with longer stride length. Elite athletes and marathon runners have reported that their taller height facilitates the completion of competitions [13]. Another source suggests that shorter individuals may benefit from a lower cardiovascular risk [14]. However, limited data is available on the effects of height on muscular endurance, muscular flexibility and aerobic capacity.

The present study aimed to determine the effect of height on the aerobic capacity of young adults using the Multistage 20 m Shuttle Run test.

MATERIALS AND METHODS

A cross-sectional study was conducted at the Department of Cardio-Respiratory Physiotherapy, College of Physiotherapy, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India, between July 2020 and July 2021. The study was proposed to the Sumandeep Vidyapeeth Institutional Ethical Committee (SVIEC) and ethical clearance was obtained (SVIECON/PHSY/DNMPTT9/D20012). After receiving approval from the ethical committee, college-going students and working professionals from the Sumandeep Vidyapeeth campus were included. Willing participants were provided with an explanation of the study and a written informed consent form was obtained from them. A participation information sheet was given to them, detailing the study.

Inclusion criteria:

- Self-declared healthy young adults aged between 18-35 years;
- Normal BMI (18.5-24.9 kg/m²) [2];
- Both males and females were recruited.

Exclusion criteria:

- Participants who had any neurological, cardiorespiratory, or musculoskeletal problems;
- Female subjects who were pregnant.

Sample size calculation: The sample size was calculated using the following formula:

Sample size (n)=$(Z^2 \times p \times (1-p)/d^2$

where, α (level of significance)=0.05,

Z (tabulated statistical value of Z at α of 0.05)=1.96,

d (error of correction)=0.02,

p (population percentage of Young Adult)=0.05 [15]

The calculated sample size was 456.

Study Procedure

The total number of participants included in the study was 106, categorised into three groups: short (22), medium (47) and tall (37) height groups. They were asked to perform the Multistage 20 m Shuttle Run test. Body weight was measured using a weighing scale (JN SON Weighing Scale) with the participant standing without shoes and with minimal movement. Body height was measured using a measuring tape, with participants asked to stand with their back against the wall, without shoes and facing forward. Using these values, BMI was calculated. Subjects falling within the range of normal BMI (18.5-24.9 kg/m²) were selected.

The Multistage 20 m Shuttle Run test [16] was conducted on a non-slippery and even surface. Before the test, each participant's heart rate and respiratory rate were recorded while seated in a relaxed state. Participants were informed about all the red flags and yellow flags related to the run test. They ran back and forth between two white lines drawn 20 m apart, marked by cones at the endpoints, while maintaining the pace with audio signals played using a metronome. Participants started running at a speed of 8.5 km/h for the first minute. Subsequently, the speed increased by 0.5 km/h each minute, thereby advancing the level of the test. The test was terminated when the participant could not reach the opposite cones for two consecutive occasions or if they expressed a willingness to stop. After the test, participants were asked to sit in a relaxed position and their heart rate and respiratory rate were recorded. The last level and stage completed by each participant were documented, along with the total distance covered and the total time taken to complete the test. These parameters were used to predict VO_2 max using the following equation:

VO_2 max (mL/kg/min)=-32.678+6.592×Maximal Aerobic Speed (MAS) [17] where maximal aerobic speed is the ratio of the distance completed in the last stage to the total time taken until the last stage.

After completing the test, the final level and stage achieved by each participant were noted in the assessment sheet. The selected participants were divided into three groups based on their heights—short, medium and tall [18]. The calculated VO_2 max was then compared among the three groups.

STATISTICAL ANALYSIS

The collected data were entered into a Microsoft Excel sheet and analysed using Statistical Package for Social Sciences (SPSS) software version 21.0. Descriptive statistics displayed the mean, standard deviation and standard error mean for all the variables. Chi-square tests were performed to identify associations between different categorical variables. Independent samples t-tests were conducted to compare and associate the means of two independent groups. One-way ANOVA was carried out to determine whether there was a statistically significant difference between the various variables and the three height groups. Post-hoc analyses were conducted to assess the significance of the relationships between the three height groups based on the variables. The level of significance (p-value) for this study was set at 0.05.

RESULTS

The mean height of all categories was 1.60±0.09 metres. The VO_2 max of all participants across all categories was 23.27±3.96 mL/kg/min. The mean values for distance covered, time taken and maximum aerobic speed by participants while performing the Multistage 20 m Shuttle Run test are also presented in [Table/Fig-1].

Demographic details	N	Minimum	Maximum	Mean±SD
Age (years)	106	18	32	21.08±2.56
Height (meters)	106	1.42	1.83	1.60±0.09
Weight (kg)	106	39.52	78.40	56.92±8.20
BMI (kg/m²)	106	18.53	24.89	22.07±2.05
Distance covered (meters)	106	100.00	1680.00	328.11±250.28
Time (Minutes: Seconds)	106	0.42	9:40	2:17±1:30
Max. aerobic speed (km/hour)	106	7.14	10.43	8.49±0.60
VO_2 max (mL/kg/min)	106	14.40	36.06	23.27±3.96

[Table/Fig-1]: Presents the demographic details and the aerobic capacity of the participants performing the Multistage 20 m shuttle Run test.

In the present study, a total of 106 participants were categorised into short-height (n=22), medium-height (n=47) and tall-height groups (n=37). Significant results were obtained for distance covered, time taken and maximum aerobic speed by participants while performing the Multistage 20 m Shuttle Run test in all three groups [Table/Fig-2].

There were significant differences in distance covered, time taken and maximum aerobic speed by participants while performing the Multistage 20 m Shuttle Run test across both genders—male and female [Table/Fig-3].

However, the results obtained were not significant for distance covered, time taken, maximum aerobic speed and maximal oxygen consumption by participants while performing the Multistage 20 m Shuttle Run test among all three height groups [Table/Fig-4].

There was no significant difference in maximal oxygen consumption in the Multistage 20 m Shuttle Run test among short, medium and tall height groups, F(2, 103)=0.072, p=0.930 [Table/Fig-5].

DISCUSSION

In the present study, no statistically significant difference was observed in maximal aerobic speed among participants of varying height categories during the Multistage 20 m Shuttle Run test {F(2, 103)=0.071, p=0.931}. These findings mirror those reported by Cavanagh PR and Kram R, who concluded that improvements in running speed are primarily a result of training rather than being

Variables		N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Min	Max	p-value
						Lower bound	Upper bound			
Age (years)	Short (≤1.49)	22	19.77	2.58	0.55	18.63	20.92	18	30	<0.001
	Medium (1.50-1.59)	47	21.87	2.62	0.38	21.10	22.64	18	32	
	Tall (≥1.60)	37	20.84	2.13	0.35	20.13	21.55	18	26	
	Total	106	21.08	2.56	0.25	20.58	21.57	18	32	
Height (meters)	Short (≤1.49)	22	1.49	0.05	0.01	1.47	1.51	1.42	1.59	0.18
	Medium (1.50-1.59)	47	1.58	0.05	0.008	1.56	1.60	1.50	1.69	
	Tall (≥1.60)	37	1.70	0.06	0.009	1.68	1.72	1.61	1.83	
	Total	106	1.60	0.09	0.009	1.59	1.62	1.42	1.83	
Weight (kg)	Short (≤1.49)	22	51.17	6.08	1.30	48.48	53.87	39.52	62.25	0.01
	Medium (1.50-1.59)	47	55.30	6.25	0.92	53.47	57.14	44.05	69.50	
	Tall (≥1.60)	37	62.38	8.38	1.38	59.58	65.17	49.60	78.40	
	Total	106	56.92	8.20	0.80	55.34	58.49	39.52	78.40	
BMI (kg/m²)	Short (≤1.49)	22	22.93	1.84	0.39	22.11	23.74	19.19	24.83	<0.001
	Medium (1.50-1.59)	47	22.12	1.88	0.27	21.57	22.68	18.64	24.82	
	Tall (≥1.60)	37	21.50	2.23	0.37	20.76	22.24	18.53	24.89	
	Total	106	22.07	2.05	0.20	21.68	22.47	18.53	24.89	
Distance covered (meters)	Short (≤1.49)	22	318.18	199.32	42.50	229.81	406.56	120.00	920.00	0.04
	Medium (1.50-1.59)	47	319.15	252.57	36.84	244.99	393.30	100.00	1180.00	
	Tall (≥1.60)	37	345.40	278.47	45.78	252.56	438.25	140.00	1680.00	
	Total	106	328.11	250.28	24.30	279.91	376.31	100.00	1680.00	
Time (Minute:Second)	Short (≤1.49)	22	2:13	1:14	0:15	1:40	2:46	0:52	5:52	0.01
	Medium (1.50-1.59)	47	2:13	1:33	0:13	1:46	2:40	0:42	7:15	
	Tall (≥1.60)	37	2:24	1:37	0:15	1:51	2:56	0:52	9:40	
	Total	106	2:17	1:30	0:08	1:59	2:34	0:42	9:40	
Max. Aerobic Speed (km/hr)	Short (≤1.49)	22	8.53	0.53	0.12	8.30	8.76	7.50	9.48	<0.001
	Medium	47	8.47	0.65	0.09	8.28	8.66	7.14	10.00	
	Tall (≥1.60)	37	8.48	0.59	0.10	8.28	8.68	7.62	10.43	
	Total	106	8.49	0.60	0.06	8.373	8.60	7.14	10.43	
VO_2 max (mL/kg/min)	Short (≤1.49)	22	23.56	3.47	0.74	22.02	25.10	16.76	29.84	<0.001
	Medium (1.50-1.59)	47	23.18	4.28	0.62	21.92	24.43	14.40	33.24	
	Tall (≥1.60)	37	23.23	3.91	0.64	21.92	24.53	17.55	36.06	
	Total	106	23.27	3.96	0.38	22.5 1	24.04	14.40	36.06	

[Table/Fig-2]: Descriptive statistics of different height categories and their relationship with different variables.
#*Independent sample t-tests **One-way ANOVA, p-value <0.05

Variables		N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	p-value
Age (years)	Male	40	2.30	0.76	0.12	0.997	<0.001
	Female	66	1.30	0.52	0.06		
Height (meters)	Male	40	1.68	0.08	0.012	0.118	<0.001
	Female	66	1.56	0.07	0.009		
Weight (kg)	Male	40	62.68	7.74	1.22	9.259	<0.001
	Female	66	53.42	6.31	0.78		
BMI (kg/m²)	Male	40	22.26	2.22	0.35	0.294	0.476
	Female	66	21.96	1.95	0.24		
	Female	66	27.14	2.88	0.35		
Distance covered (in meters)	Male	40	500.00	315.16	49.83	276.061	<0.001
	Female	66	223.94	111.34	13.70		
Time (Minutes: Second)	Male	40	2:27	1:14	0:11	00:47	<0.001
	Female	66	1:39	0:47	0:05		
Max. Aerobic Speed (km/hr)	Male	40	8.57	0.52	0.08	0.205	0.057
	Female	66	8.36	0.54	0.07		
VO_2 max (mL/kg/min)	Male	40	24.74	3.83	0.60	2.362	0.003
	Female	66	22.38	3.80	0.47		

[Table/Fig-3]: Estimates the mean, standard deviation and p-value for both gender groups concerning each variable.

influenced by physical attributes such as foot length or body height [19]. Instead, physiological variables play a more critical role in performance.

Maximal oxygen consumption (VO_2 max, measured in mL/kg/min) showed a significant difference between male and female participants. This outcome is consistent with the findings of Alexander MJ, who found that males typically exhibit higher VO_2 max levels, greater anaerobic capacity and superior muscle strength during endurance activities [20].

The gender disparity in VO_2 max can be explained by anatomical, physiological and biomechanical differences. Anatomically, females tend to have shorter average heights, different body compositions, lower muscle mass, smaller bone structures and reduced heart and lung sizes compared to males [21,22]. Physiologically, females generally have lower stroke volume due to smaller heart chamber dimensions, which leads to reduced cardiac output. Additionally, females often exhibit lower systolic and diastolic blood pressure, reduced haemoglobin concentrations and approximately 6% fewer red blood cells than males [23]. These factors collectively diminish oxygen-carrying capacity and endurance performance. Smaller lung volumes further contribute to increased breathing effort, greater expiratory limitations and delayed recovery following intensive exercise. Muscle bulk and strength in both the upper and lower extremities are typically lower in women [24,25].

Dependent variables			Mean difference (I-J)	Std. error	Sig. (p-value)	95% confidence interval	
						Lower bound	Upper bound
Gender	Short	Medium	-0.020	0.124	0.985	-0.32	0.28
		Tall	0.195	0.130	0.291	-0.11	0.50
	Medium	Short	0.020	0.124	0.985	-0.28	0.32
		Tall	0.216	0.106	0.108	-0.04	0.47
	Tall	Short	-0.195	0.130	0.291	-0.50	0.11
		Medium	-0.216	0.106	0.108	-0.47	0.04
Distance covered (in meters)	Short	Medium	-0.96712	65.19454	1.000	-156.0042	154.0699
		Tall	-27.22359	67.94551	.915	-188.8026	134.3554
	Medium	Short	.96712	65.19454	1.000	-154.0699	156.0042
		Tall	-26.25647	55.46727	0.884	-158.1614	105.6485
	Tall	Short	27.22359	67.94551	0.915	-134.3554	188.8026
		Medium	26.25647	55.46727	.884	-105.6485	158.1614
Time (Mins:Seconds)	Short	Medium	-0:00	0:23	1.000	-0:56	0:55
		Tall	-0:10	0:24	0.900	-1:09	0:47
	Medium	Short	0:00	0:23	1.000	-0:55	0:56
		Tall	-0:10	0:20	0.860	-0:58	0:37
	Tall	Short	0:10	0:24	0.900	-0:47	1:09
		Medium	0:10	0:20	0.860	-0:37	0:58
Max. Aerobic Speed (km/hr)	Short	Medium	0.058036	0.156599	0.927	-0.31437	0.43044
		Tall	0.047984	0.163207	0.953	-0.34013	0.43610
	Medium	Short	-0.058036	0.156599	0.927	-0.43044	0.31437
		Tall	-0.010052	0.133234	0.997	-0.32689	0.30679
	Tall	Short	-0.047984	0.163207	0.953	-0.43610	0.34013
		Medium	0.010052	0.133234	0.997	-0.30679	0.32689
VO_2 max (mL/kg/min)	Short	Medium	0.382584	1.032843	0.927	-2.07359	2.83875
		Tall	0.332385	1.076425	0.949	-2.22743	2.89220
	Medium	Short	-0.382584	1.032843	0.927	-2.83875	2.07359
		Tall	-0.050199	0.878739	0.998	-2.13990	2.03950
	Tall	Short	-0.332385	1.076425	0.949	-2.89220	2.22743
		Medium	0.050199	0.878739	0.998	-2.03950	2.13990

[Table/Fig-4]: Estimates all variables' mean and standard deviation and p-value according to comparison of each heighted group. Post-hoc analyses between the different heights groups of all variables.

Variables		Sum of squares	df	Mean squares	F	p-value
Distance covered (meters)	Between groups	17010.49	2	8505.25	0.134	0.875
	Within groups	6560412.15	103	63693.32		
	Total	6577422.64	105			
Time (Minutes: Seconds)	Between groups	9707519.49	2	4853759.75	0.162	0.851
	Within groups	3084883589.94	103	29950326.12		
	Total	3094591109.43	105			
Max. Aerobic Speed (km/hr)	Between Groups	0.05	2	0.03	0.071	0.931
	Within groups	37.85	103	0.37		
	Total	37.90	105			
VO_2 max (mL/kg/min)	Between Groups	2.32	2	1.16	0.072	0.930
	Within Groups	1646.56	103	15.99		
	Total	1648.88	105			

[Table/Fig-5]: Comparative analysis of VO_2 max between and within group.

Biomechanically, even with equivalent training and body weight, females may differ in muscle stiffness, recruitment efficiency, postural control, reaction time, proprioception and hormonal profiles—all of which impact cardiovascular and respiratory output [21,22]. No significant variation was found in the total distance covered during the Shuttle Run test among participants grouped by height ($F(2, 103)=0.134$, $p=0.875$). Debaere S et al., also emphasised that performance in different running phases is affected by multiple factors and that leg length does not necessarily predict better outcomes [23]. Similarly, Otsuka M et al., noted that body height had minimal influence on run time, whereas physical fitness and technique played more substantial roles [24].

There was also no significant difference in VO_2 max values across the short, medium and tall height groups {$F(2, 103)=0.072$, $p=0.930$}. These results are consistent with the work of Akalan C et al., who identified training status, age and genetic factors—not body height—as primary determinants of VO_2 max [17]. Maldonado S et al., also reported a negative association between height and running economy, suggesting that taller individuals do not always have performance advantages [25]. A study by Astorino TA et al., further confirmed that training regimen and physiological adaptations are more influential than body composition in determining VO_2 max [26].

Maximal oxygen consumption remains a fundamental indicator of overall fitness. The endurance levels of physically active individuals may offset any influence of stature. This view is supported by Mikaelsson K et al., who demonstrated that active adults possess higher aerobic capacity and reduced cardiovascular disease risk compared to their sedentary counterparts [27].

Based on these findings, the study concludes that training intensity and physiological factors largely determine aerobic endurance. Maintaining moderate to high aerobic capacity can play a critical role in lowering the risk of metabolic and cardiovascular conditions.

Limitation(s)

One limitation of the present study was the relatively small sample size. Conducted as part of a postgraduate research project, data collection was significantly affected by the nationwide Coronavirus Disease 2019 (COVID-19) lockdown in India. The second wave, which began in July 2022, further restricted recruitment and by that point, only 106 participants had been enrolled. Due to the proximity of scheduled university examinations, extending the study duration was not feasible. Following internal discussions between the principal investigator and the research guide, the sample size was finalised at 106. Additionally, the study was carried out during the COVID-19 pandemic, which introduced external variables such as reduced air pollution and varying immune responses. These factors may have influenced participant endurance levels but fall outside the scope of this investigation, thus limiting the interpretability of the findings.

CONCLUSION(S)

The study concludes that the multistage 20 m shuttle run test can be a determining factor in assessing the effect of height on the aerobic capacity of young adults. This study also infers that aerobic capacity is not affected by the body height of young adults. Future recommendations include predicting and comparing VO_2 max using two different submaximal tests or a submaximal and a maximal test in one study. This approach will yield a more accurate value of VO_2 max and could serve as a measure of the reliability of a particular test and/or equation.

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