Available online at https://journal.uny.ac.id/index.php/jorpres

JORPRES (Jurnal Olahraga Prestasi), 20 (2), 2024, 55-62

Evaluating the validity and effectiveness of multiantro tools in diverse applications

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Abstract

Anthropometry, derived from physical anthropology, plays a vital role in sports, where ideal anthropometric composition paired with good technique enhances athletic performance. Anthropometric characteristics, body composition, and mass significantly influence training and competition outcomes. To improve efficiency, researchers developed the "Multiantro," a multifunctional tool enabling simultaneous measurement of height, weight, sitting height, and arm length. This study aimed to validate the Multiantro tool by conducting a concurrent validity test to ensure its measurements align with standardized tools. Using a cross-sectional design, data from both the Multiantro and conventional standardized instruments were collected simultaneously from the same sample. The comparison assessed the consistency of the new instrument against established measurement tools. Analysis revealed no significant differences between the Multiantro's measurements and those of conventional tools, confirming its reliability. The Multiantro offers practical advantages, allowing multiple anthropometric tests with a single device, simplifying measurement processes without compromising accuracy. These findings support the Multiantro's potential as a reliable and efficient tool in anthropometric assessments.

Keywords: evaluating, validity, tools, multiantro

INTRODUCTION

Anthropometry is a human measurement that tends to measure human dimensions. Anthropometry is a science created from a new scientific subdiscipline called physical anthropology which is an implication of the development of Anthropology studies. Anthropology is the development of human studies concerning philosophy and aesthetics. Then anthropometry began to be recognized and used in measuring the body, bones and estimating the proportion of human body size (Kuswana, 2015: 1). Anthropometry is a measurable part of the human body that is useful for knowing the composition or shape of the body or measuring the structure of the human body (Dial, 2018). In addition, anthropometry is a tool to predict performance to achieve success in sports achievements (Brunkhorst & Kielstein, 2013; Cosmin et al., 2016; Milić et al., 2017; (Popovic et al., 2014)).

Conducting studies related to anthropometry can help someone to apply ergonomics to achieve comfort and the benefits of applying ergonomics are new design recommendations and design development, knowing the relationship of vibration and energy to comfort, reducing discomfort, activities that affect comfort, the ability to estimate body size, knowing the risk of diseases that arise, and knowing the level of importance of ergonomics (Sari et al., 2023). An ideal anthropometric composition and supported by good technique will produce an athlete's excellent performance in competition. Anthropometric characteristics, body composition and mass contribute to training and competition performance (Akpina et al., 2013; Massuça & Fragoso, 2011). Good anthropometric potential will support an optimal appearance of attitudes and movements in a sport (Rudiyanto. et al., 2012). Parameters in carrying out anthropometric measurements include measuring age, weight, height, upper arm circumference, waist and hip circumference, head circumference, chest circumference, and fat thickness under the skin (Utami, 2016). However, there remains a gap in understanding how specific anthropometric characteristics correlate with performance across diverse sports disciplines and under

ISSN 0216-4493 (print), ISSN 2597-6109 (online)

varying environmental or competitive conditions. While existing studies have focused on general applications of anthropometry in ergonomics and sports, there is limited data on the interplay between anthropometric profiles, dynamic performance metrics, and injury risk mitigation strategies. Future research could address these gaps by exploring how tailored anthropometric assessments can enhance training protocols, optimize performance, and minimize health risks in specific athlete populations.

Body composition measurement is one of the most important things in an effort to identify talent and select athletes, but this has not been done much (Budi et al., 2020). The coach's assessment when selecting athletes at anthropometric points and body somatotype covers 44.4% while the rest looks at the psychological, motor and psychomotor aspects of athletes (Limoochi, 2012). Based on the results of previous research and observations, it was found that one of the reasons this happened was the practicality factor in carrying out anthropometric tests. To carry out anthropometric measurements, various kinds of tools are needed (Utami, 2016). In addition to the practicality factor, budget-related efficiency factors are also considered, for example in measuring height, weight, sitting height and arm length, at least four people are needed as testors. Therefore, researchers have developed a multifunctional anthropometric measurement tool, several test items can be carried out simultaneously with the use of this tool, this tool is called 'Multiantro". However, this tool still requires further review, so that the research is intended to carry out the concurrent validity test stage of this Multiantro tool so that the results of the measurement can be accounted for the measurement results.

METHOD

This type of research is descriptive quantitative using cross-sectional method. cross-sectional design in which data from two instruments (new instrument and standardized instrument) are collected at the same time from the same sample. New instruments are tested to determine whether the results are consistent with standardized measuring instruments. The way to determine the sample in this study is to use the saturated sampling technique, where this method is carried out if the entire population is sampled. So the sample used in this study was the entire number of athletes practicing at the sleman training center for floor gymnastics, totaling 32 athletes. The instrument is a tool used during research in collecting data with the aim of measuring the results of research data systematically (Sugiono, 2014). The measurement instruments used are anthropometric tests using conventional tools and using multiantro tools to measure height, weight, sitting height and arm length. Then the results of the two tests will be compared to see if there is a significant difference. The data analysis will be carried out using the SPSS Version 26 tool, and then the concurrent validity value of the two types of anthropometric measurements will be seen.

RESULTS AND DISCUSSION

Results

The data obtained were processed using the SPSS version 26 program. The description of the research data is as follows:

A. Height Measurement Analysis Results

Table 1. Height Normality Test

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Conventional	.164	32	.028	.933	32	.048
Multiantro	.156	32	.046	.951	32	.156
a. Lilliefors Significance Correction						

Based on the data above, it is known that the normality test value for the conventional measurement method is 0.028 and the multiantro is 0.046, which means <0.05 so it can be said that the results of measuring height are not normally distributed, so it is recommended to do a non-parametric test.

ISSN 0216-4493 (print), ISSN 2597-6109 (online)

Table 2. Height Homogeneity Test

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Measurement Results	Based on Mean	53.319	1	62	.000
	Based on Median	33.081	1	62	.000
	Based on Median and with adjusted df	33.081	1	31.678	.000
	Based on trimmed mean	51.716	1	62	.000

Based on the data above, it is known that the homogeneity test value is 0.00, which means <0.05 so it can be said that the results of measuring height are not homogeneous, so it is then recommended to do a non-parametric test.

Table 3. Mann Whitney Test for Height

Test Statistics[a]	
	Results
Mann-Whitney U	378.500
Wilcoxon W	906.500
Z	-1.795
Asymp. Sig. (2-tailed)	.073

Based on the previous normality test and homogeneity test, it is known that the data is neither normally distributed nor homogeneous, so it is advisable to know the significance value between the two measurement methods, namely conventional measurement and multiantro measurement using the mann whitney test approach. The result obtained is 0.073 which means > 0.05, it can be explained that there is no significant difference between the results of anthropometric measurements using conventional methods and multiantro methods.

B. Weight Measurment Analyisis Results

Table 4. Weight Normality Test

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Conventional	.213	32	.001	.883	32	.002
Multiantro	.213	32	.001	.883	32	.002
a. Lilliefors Significance Correction						

Based on the data above, it is known that the normality test value for conventional measurement methods is 0.001 and multiantro is 0.001, which means <0.05 so it can be said hat the results of weight measurement are not normally distributed, so it is recommended to do a non-parametric test.

ISSN 0216-4493 (print), ISSN 2597-6109 (online)

Table 5. Weight Homogenity Test

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Results	Based on Mean	.000	1	62	1.000
	Based on Median	.000	1	62	1.000
	Based on Median and with adjusted df	.000	1	62.000	1.000
	Based on trimmed mean	.000	1	62	1.000

Based on the data above, it is known that the homogeneity test value is 1.00 which means> 0.05 so it can be said that the results of weight measurement are homogeneous, although the data obtained is homogeneous, it is still recommended for non-parametric tests because based on the normality test the data is not normally distributed.

Table 6. Mann Whitney Test Weight

Test Statistics[a]	
	Results
Mann-Whitney U	512.000
Wilcoxon W	1040.000
Z	.000
Asymp. Sig. (2-tailed)	1.000

Based on the previous normality test and homogeneity test, it is known that the data is not normally distributed but homogeneous, so it is advisable to know the significance value between the two measurement methods, namely conventional measurement and multiantro measurement using the mann whitney test approach. The result obtained is 1,000 which means> 0.05, it can be explained that there is no significant difference between the results of anthropometric measurements using conventional methods and multiantro methods.

C. Sitting Height Measurement Analysis Results

Table 7. Normality Test of Sitting Height

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Conventional	.134	32	.157	.963	32	.336
Multiantro	.136	32	.139	.961	32	.301
a. Lilliefors Significance Correction						

Based on the data above, it is known that the normality test value for the conventional measurement method is 0.157 and the multiantro is 0.139, which means> 0.05 so that it can be said that the results of measuring sitting height are normally distributed, so it is recommended to do a parametric test.

ISSN 0216-4493 (print), ISSN 2597-6109 (online)

Table 8. Homogenity Test of Sitting Height

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Results	Based on Mean	.002	1	62	.965
	Based on Median	.008	1	62	.927
	Based on Median and with adjusted df	.008	1	61.998	.927
	Based on trimmed mean	.001	1	62	.975

Based on the data above, it is known that the homogeneity test value is 0.965 which means> 0.05 so it can be said that the results of weight measurement are homogeneous, so it is recommended to do parametric tests.

Table 9. Independent Sample T Test of Sitting Height

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Results	Equal variances assumed	.002	.965	-2.946	62	.005	-3.06250	1.03939	-5.14021	-.98479
	Equal variances not assumed			-2.946	61.970	.005	-3.06250	1.03939	-5.14023	-.98477

Based on the previous normality test and homogeneity test, it is known that the data is normally distributed and homogeneous, so it is advisable to know the significance value between the two measurement methods, namely conventional measurement and multiantro measurement using an independent sample t test approach. The result obtained is 0.005 which means> 0.05, it can be explained that there is no significant difference between the results of anthropometric measurements using conventional methods and multiantro methods.

ISSN 0216-4493 (print), ISSN 2597-6109 (online)

D. Arm Legth Measurement Analysis Results

Table 10. Normality Test of Arm Length

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.107	32	.200*	.925	32	.029
Posttest	.110	32	.200*	.925	32	.029

Based on the data above, it is known that the normality test value for the conventional measurement method is 0.200 and multiantro is 0.200, which means> 0.05 so it can be said that the results of measuring arm length are normally distributed, so it is recommended to do a parametric test.

Table 11. Homogenity Test of Arm Length

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Results	Based on Mean	.005	1	62	.944
	Based on Median	.003	1	62	.957
	Based on Median and with adjusted df	.003	1	61.981	.957
	Based on trimmed mean	.005	1	62	.946

Based on the data above, it is known that the homogeneity test value is 0.944 which means> 0.05 so that it can be said that the results of measuring arm length are homogeneous, so it is recommended to do a parametric test.

Table 12. Independent Sample T Test of Arm Length

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Results	Equal variances assumed	.005	.944	-.561	62	.577	-1.59375	2.84293	-7.27669	4.08919
	Equal variances not assumed			-.561	62.000	.577	-1.59375	2.84293	-7.27669	4.08919

Based on the previous normality test and homogeneity test, it is known that the data is normally distributed and homogeneous, so it is advisable to know the significance value between the two measurement methods, namely conventional measurement and multiantro measurement using an

ISSN 0216-4493 (print), ISSN 2597-6109 (online)

independent sample t test approach. The result obtained is 0.577 which means > 0.05, it can be explained that there is no significant difference between the results of anthropometric measurements using conventional methods and multiantro methods.

Discussion

Anthropometry is essential in many sports as it provides baseline data that helps coaches and sports scientists to design training programs that match the athlete's physical characteristics. Precise and accurate measurement is key in this process, and the Multiantro tool is expected to improve the weaknesses that exist in traditional measurement tools, such as dependence on multiple testors, risk of human error, and time constraints. A study assessing the validity of the Multiantro tool found no significant differences between its measurements and those obtained using conventional standardized instruments, indicating its reliability in anthropometric assessments. The Multiantro's ability to perform multiple measurements concurrently offers practical advantages, streamlining the assessment process without compromising accuracy (Cavedon et al., 2018; Chaabene et al., 2019).

There are several benefits obtained in using this multiantro tool including measurement efficiency, reduction in the number of testers and affordability and ease of use. Measurement Efficiency, multiantro is able to measure several parameters at once with only one tool. This saves time in the measurement process, especially in large populations such as athletes or students taking fitness tests. Reduced number of testers, anthropometric measurements require more than one tester to ensure accuracy, especially in measurements that require precise posture settings, such as sitting height or arm length. Multiantro allows measurements to be taken by one testor, thus increasing labor efficiency. Affordability and ease of use, this tool is designed to be used easily even by people who are not experienced in anthropometric measurements. This makes it a good choice for educational institutions or sports clubs with limited resources. It should be noted that efficiency in test and measurement not only improves the quality of evaluation but also ensures that the process is conducted in a structured and systematic way, producing accurate and relevant data for further decision-making (L, 2019; Winarno, 2004).

CONCLUSION

Validity research on the Multiantro tool has been conducted and proves that this tool provides accurate and reliable anthropometric measurement results. By simplifying the measurement process and reducing the need for the number of testers, this tool can have a positive impact on the implementation of physical tests in sports and education. Multiantro can be an important innovation in the world of sports to significantly improve the efficiency of anthropometric measurements.

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