

Validity Reliability and Standard Norm of Multistage Fitness Test for Measuring the Cardiorespiratory Endurance of the Junior High School Students Located in Kudus Regency



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ABSTRACT: This research aims to: (1) assess the validity of the Multistage Fitness Test for measuring cardiorespiratory endurance of the junior high school students located in Kudus Regency, (2) evaluate the reliability of the Multistage Fitness Test for this population, (3) establish standard norms for the Multistage Fitness Test, and (4) analyze the cardiorespiratory endurance results of junior high school students using the developed standard norms. This research employed a descriptive quantitative design utilizing a survey methodology. The research participants consisted of junior high school students from Kudus Regency. The sample consisted of 249 students selected through stratified sampling. This research utilized the Multistage Fitness Test as its data collection instrument. This research employed a validity test through Pearson correlation analysis, a reliability test via Intraclass Correlation Coefficient correlation, and established standard norms using average values and standard deviations. The research concludes that: (1) the validity coefficient of the Multistage Fitness Test is at -0.990, categorizing it as very high, and (2) the reliability test of the Multistage Fitness Test is at 0.98, placing it in the high category, thus confirming its suitability as an instrument for measuring cardiorespiratory endurance of the junior high school students in Kudus Regency. (3) The Multistage Fitness Test gains five standard norms: ≥ 42.60 (very good); $35.37 < 42.60$ (good); $28.14 < 35.37$ (moderate); $20.91 < 28.14$ (poor); and ≤ 20.91 (very poor). Consequently, each student's test result can be classified into one of the categories. (4) The results of the student's cardiorespiratory endurance test can be determined based on established standard norms. The distribution of categories is as follows: very good at 9%, good at 22%, moderate at 33%, poor at 34%, and very poor at 2%. It can be concluded that junior high school students in Kudus Regency show the cardiorespiratory endurance categorized as poor than optimal.

KEYWORDS: Cardiorespiratory Endurance, Multistage Fitness Test, Reliability, Standard Norms, Validity

I. INTRODUCTION

Sports education has an important role in improving health, fostering the younger generation, and achieving achievements. Sports education in formal education is part of the process and achievement of national development goals so that the existence and role of sports in social life must be placed in a clear position. As a formal educational institution, schools are obliged to develop the potential of students optimally which includes the development of cognitive, affective, and psychomotor aspects in a balanced manner.

One of the efforts to develop students' potential is through physical education. Physical education is part of the overall subjects taught at school and cannot be separated from other education; in fact it is a very important part of education in supporting other educational processes. Physical activity is a planned and structured activity that involves repetitive body movements that aim to build physical strength and affect cardiorespiratory endurance, especially in young adolescents who have just reached puberty. Physical education provides a reflection of a healthy lifestyle in an educational environment with the aim of finding out the effects of classes with the implementation of physical education on health-related fitness levels (Liu, et al., 2017, p. 53). Exercise is a basic need in the form of planned and scheduled body activities involving repetitive body movements shown to train learners' physical fitness affecting cardiorespiratory endurance, especially in young adolescents who are just experiencing puberty. Junior high school students are on average 13-15 years old. In this phase the growth of children goes well because of the transition from children to adolescents. Physical fitness in this phase needs to be maintained so that the growth of students goes well.

Validity Reliability and Standard Norm of Multistage Fitness Test for Measuring the Cardiorespiratory Endurance of the Junior High School Students Located in Kudus Regency

Good physical fitness can be seen from the level of cardiorespiratory endurance. The level of cardiorespiratory endurance is needed in daily activities because it can affect the quality of a learner. Cardiorespiratory fitness reflects the ability of the heart and lungs to circulate blood containing oxygen efficiently so that it can meet the metabolic needs of muscles while working during sports activities (Chu et al., 2020, p. 45). Good cardiorespiratory fitness will affect the development of learners' skills in completing daily activities without experiencing fatigue. Learners with good cardiorespiratory are able to follow learning with enthusiasm and high motivation to get maximum learning results. Learners with good cardiorespiratory are also able to think with high thinking power, creative mindset, and high concentration. But in reality the cardiorespiratory endurance of junior high school students in the category is very lacking. Research (Istifarin & Oce, 2024, p. 195) shows that the cardiorespiratory endurance of junior high school students is in the very poor category. Learners with poor cardiorespiratory endurance will interfere with learning ability and are more susceptible to disease. As a result, learning objectives are not well achieved so teachers need to measure the level of cardiorespiratory endurance of students.

Cardiorespiratory endurance is one of the most important components for students. To find out the level of endurance of learners, an assessment needs to be done. Laboratory testing is an objective and accurate method of assessing physical fitness but it is costly, requires qualified experts, and time constraints. Under these conditions, field fitness testing can be a useful alternative because it is relatively safe, saves time, requires simple equipment, is low cost, and can easily be done by many people simultaneously. Several assessments to measure cardiorespiratory endurance have been designed by several experts, including: (a) Multistages Fitness Test (b) Harvard Step Test, (c) 12-minute run or walk test. Of the several tests designed by these experts, in principle, have almost the same measurement targets, namely measuring the level of general endurance. The Multistages Fitness Test is the most widely used field-based test to assess cardiorespiratory fitness (Jimenez, N.M., et al, 2023, p. 268). Research by Leger, et al (1988, p. 95) states that the validity level of the Multistages Fitness Test is 0.72 while the reliability level of the Multistages Fitness Test for adolescents is $r = 0.89$.

The results of the literature review study show that research related to validity, reliability, and norm standards of assessment instruments has been widely conducted. However, research on assessment instruments to measure cardiorespiratory endurance, especially the Multistages Fitness Test in Indonesia is still relatively few. Research conducted by Aertssen, et al. (2024, p. 4) on the reliability and validity of the modified shuttle test-paeds with a correlation of 0.78 and a reliability value of 0.84. Other research on the validity and reliability of assessment instruments was conducted by Pramdhan, et al. (2021, p. 101) regarding the validity and reliability of the VO₂max test for U-18 soccer players, the validity test results obtained a result of 0.408 and the reliability test obtained a result of 0.875 so that the instrument can be used as a Vo₂max test instrument.

From the tests created by experts several decades ago, it does not always have the level of accuracy, reliability, and assessment norms that are still relevant to be used to measure the level of cardiorespiratory endurance today. Ngatman & Fitria (2017, p. 20), assessment tools can be said to be good if they are valid, reliable, objectivity, have norms, easy administration, age and gender suitability, educational value, test discrimination, safety, and test type. The cardiorespiratory level of students who were sampled or subjects at the time the test was made/issued several years ago is not necessarily the same as the conditions that occur now (Roetert & Kovacs, 2019). Environmental and weather factors can also affect test results so that the instrument needs to be reviewed to determine its reliability. Aandstad, et al. (2011, p. 513) The Multistages Fitness Test developed by Leger is usually conducted indoors, reducing the challenges associated with outdoor testing. In addition, due to changes in learners' physical abilities such as changes in lifestyle, diet, or physical activity levels, the standard norms of the MFT instrument need to be reorganized. Along with the development of sports today, an in-depth review is needed to see whether the test is still adequate and feasible to use to measure cardiorespiratory endurance for students. Ngatman, et al. (2023, p. 5112), one of the assessment instruments in order to have a reliable level of assessment accuracy from time to time must be reviewed periodically.

This periodic review is intended to see whether the instrument is still suitable for use as one of the standardized instruments or not. Periodic retesting of assessment instruments will avoid assessment instruments that are inaccurate / accurate and out of date. Testing of assessment instruments must always be carried out to ensure that the instruments used meet the criteria for a good assessment instrument. An assessment instrument is considered to meet the requirements of a good instrument if it is at least: (1) valid, (2) reliable, (3) objective, and (4) relevant (Ngatman, 2023, p. 5112).

The preliminary study information was explored through a needs analysis using a questionnaire instrument given to teachers and students. The current condition of the assessment of the level of endurance for students has several problems, including: (a) some schools have never assessed the cardiorespiratory endurance of students, (b) the assessment carried out by some teachers on the level of cardiorespiratory endurance still uses expert assessment instruments from abroad several decades ago which are not necessarily valid, reliable, and have norm standards when used with the conditions of today's students, (c) the assessment is only based on the learning process so that the level of accuracy, reliability, and suitability of the assessment is still questionable.

Validity Reliability and Standard Norm of Multistage Fitness Test for Measuring the Cardiorespiratory Endurance of the Junior High School Students Located in Kudus Regency

The results of the search through the questionnaire show that students really need a standardized assessment instrument that can be used to assess the level of endurance of students. With regard to this, it is important to conduct research on the validity, reliability, and norm standards of the Multistages Fitness Test instrument to be used as an assessment instrument to measure cardiorespiratory endurance for public junior high school students in Kudus Regency.

II. METHOD

This research is a quantitative descriptive study using a survey method with data collection techniques using test- retest. Test-retest is a term used to describe the properties of measuring instruments that are evaluated twice at different times (Berchtold, 2016, p. 1). The retest uses the same instrument and is conducted twice with different implementation times.

The location used in this study is the field of each school to determine the results of the cardiorespiratory endurance test so as identify the validity, reliability, and norm standards of the Multistages Fitness Test assessment instrument. This research was conducted twice with the time span between test 1 and test 2 was 1 week. This research was conducted in January 2025.

The sampling technique in this study was carried out using stratified sampling technique. Stratified sampling is a sampling technique in which the population is divided into several strata based on geographic location (city area, buffer area, and rural area), then the sample is taken proportionally from each stratum. The sample in this study were all students of public junior high schools totaling 6 schools with a total of 249 students.

The method for data collection in this study used a survey method with data collection techniques using test-retest. To test the accuracy of the test measurement results, the data analysis techniques used in this study are as follows:

1. This research will test concurrent criterion validity. This validity measures the extent to which the results of a test are correlated with other relevant criteria (Yusup, 2018, p. 19). From the Multistages Fitness Test results, the ranking of each research sample will be known from the highest rank to the lowest rank. To determine the level of validity of concurrent criteria, the best data from the Multistages Fitness Test test and retest results (X) are correlated with the ranking of the Multistages Fitness Test results so that the validity coefficient of the test will be known. Validity testing in the Multistage Fitness Test instrument uses the Pearson product moment validity test. The formula is as follows.

$$r = \frac{N \sum(XY) - \sum X \sum Y}{\sqrt{[N \sum X^2 - (\sum X)^2] \cdot [N \sum Y^2 - (\sum Y)^2]}}$$

Unknown:

r : Correlation coefficient

n : Number of respondents

$\sum XY$: Sum of multiplication of X and Y

$\sum X$: Sum of X scores

$\sum Y$: Sum of Y scores

$\sum X^2$: Sum of squares of X scores $\sum Y^2$: Sum of squares of Y scores

2. To determine the reliability of the Multistages Fitness Test, the data from the results of the testretest is carried out by correlating measurement results of the first test and the second test. Reliability testing in the Multistage Fitness Test instrument uses Intraclass Correlation Coefficients (ICC) with the help of SPSS v. 25. Yusup (2018, p. 19) reliability testing with test- retest is tested with product moment correlation to find the correlation coefficient. The formula is as follows:

$$r = \frac{N \sum(XY) - \sum X \sum Y}{\sqrt{[N \sum X^2 - (\sum X)^2] \cdot [N \sum Y^2 - (\sum Y)^2]}}$$

Unknown:

r : Correlation coefficient

n : Number of respondents

$\sum XY$: Sum of multiplication of X and Y

$\sum X$: Sum of X scores

$\sum Y$: Sum of Y scores

$\sum X^2$: Sum of squares of X scores $\sum Y^2$: Sum of squares of Y scores

3. To determine the norm standard of the Multistages Fitness Test assessment instrument, the test results were analyzed for the average value (mean). and its standard deviation. Ngatman (2017, p. 74) states that the statistical measure used for norm reference is the mean value (mean) and standard deviation (SD). Furthermore, the results of the average and standard deviation are converted into a table of assessment norm categories as follows.

4.

Validity Reliability and Standard Norm of Multistage Fitness Test for Measuring the Cardiorespiratory Endurance of the Junior High School Students Located in Kudus Regency

Table 1. Norm Categories

Category Norm	Category
$\bar{x} + 1,5 \text{ SD}$ and above	Very good
$\bar{x} + 0,5 \text{ SD}$ s/d $< \bar{x} + 1,5 \text{ SD}$	Good
$\bar{x} - 0,5 \text{ SD}$ s/d $< \bar{x} + 0,5 \text{ SD}$	Medium
$\bar{x} - 1,5 \text{ SD}$ s/d $< \bar{x} - 0,5 \text{ SD}$	Bad
Less than $\bar{x} - 1,5 \text{ SD}$	Very Bad

Ngatman (2023, p. 5114)

III. RESULT AND DISCUSSION

A. Result

The complete data description of the research results will be presented as follows:

1. Multistage Fitness Test Validity

Validity is tested using test and retest data from the Multistage Fitness Test (X) and ranking assessment results (Y). Based on the Multistage Fitness Test results, the ranking of each sample will be known starting from ranking 1-249. Multistage Fitness Test results and Multistage Fitness Test ranking results are correlated so that the validity coefficient of the test will be known. The validity test was carried out with pearson product moment analysis. The results of the validity test with the help of spss in this study are as follows:

Table 2. Validity Correlation Classification Results

Correlations			
		Results	Ranking
Results	Pearson Correlation	1	-.990**
	Sig. (2-tailed)		.000
	N	249	249
Ranking	Pearson Correlation	-.990**	1
	Sig. (2-tailed)	.000	
	N	249	249
**. Correlation is significant at the 0.01 level (2-tailed).			

Based on the table, it is known that the validity of the Multistage Fitness Test has a coefficient of -0.990. Based on the classification of validity according to Jimenez, et al. (2023, p. 269), the validity of the Multistage Fitness Test to measure the cardiorespiratory endurance of public first school students in Kudus Regency is in a very high category. Thus it can be concluded that the Multistage Fitness Test is valid for measuring the cardiorespiratory endurance of public junior high school students 2. Multistage Fitness Test Reliability

The reliability of the Multistage Fitness Test was tested using the test-retest results of public junior high school students. The results of the first test and the second test were correlated using Intraclass Correlation Coefficients (ICC) with the help of SPSS v. 25. It is known that the Multistage Fitness Test reliability coefficient is 0.989. Based on the standard norm of the reliability coefficient according to Jimenez, et al (2023, p. 269) the level of reliability of the Multistage Fitness Test to measure cardiorespiratory endurance is included in the high category. Thus it can be concluded that the Multistage Fitness Test is reliable to measure the cardiorespiratory endurance of public junior high school students.

3. Norm Standard

Based on the data from the Multistage Fitness Test test results to measure cardiorespiratory endurance, the average value (mean) is 31.76 and the standard deviation (SD) is 7.23. The average value and standard deviation are then converted into the norm category table which can be seen in table 3.

Validity Reliability and Standard Norm of Multistage Fitness Test for Measuring the Cardiorespiratory Endurance of the Junior High School Students Located in Kudus Regency

Table 3. Standard Norms for Multistage Fitness Test Assessment

Norm Range	Frequency	Percentage	Category
$\geq 42,60$	22	9%	Very good
$35,37 \leq 42,6$	55	22%	Good
$28,14 \leq 35,36$	82	33%	Medium
$20,91 < 28,13$	84	34%	Bad
$\leq 20,91$	6	2%	Very Bad
Total	249	100%	

Based on the results of the norm standard table, it can be seen that each test result of cardiorespiratory endurance public junior high school students can be included in one of its categories. This can be proven by looking at the range of norms, it can be seen that the level of cardiorespiratory endurance of students is in the category of excellent, good, moderate, poor, or very poor. Norm standards provide clear divisions based on test results so that learners can easily be put into categories that describe their level of cardiorespiratory endurance.

Based on this table, it can be seen that the results of the assessment of cardiorespiratory endurance at SMPN in Kudus Regency are 249 students, 9% of whom are in the very good category, 22% in the good category, 33% in the moderate category, 34% in the bad category, and 2% in the very bad category. From the results of these percentages it can be seen that the cardiorespiratory endurance of public junior high school students in Kudus Regency is in the poor category.

B. Discussion

Based on the results of the data analysis, it shows that the validity coefficient of the Multistage Fitness Test test correlated with the ranking of test results is -0.990. The test validity coefficient results are negative because one of the correlated data, namely the ranking of test results, in this study is inversion data. Based on the standard norms proposed by Jimenez, et al. (2023, p. 269) Multistage Fitness Test is included in the very high category. This proves that the Multistage Fitness Test can be used as a measuring tool for the cardiorespiratory endurance of public junior high school students because it has very high validity. The validity of the Multistage Fitness Test is measured using a correlation coefficient that shows the extent to which the test can measure according to its measuring function, namely cardiorespiratory endurance. Cardiorespiratory endurance refers to the body's ability to efficiently supply oxygen to the muscles during sustained physical activity. With a very high correlation coefficient, it can be concluded that the Multistage Fitness Test can measure cardiorespiratory endurance accurately. This is also because the difficulty level of the test increases over time so that learners must adjust to a higher speed. Learners who have good cardiorespiratory endurance will be able to last longer. This is in line with research conducted by Aandstad, et al. (2011) proving the validity level of the 20 meter shuttle run test conducted on members of the army has an instrument validity of 0.80 so that it is included in the good category and reliability of 0.95 can be concluded to have a high level of reliability.

The results of the Multistage Fitness Test reliability analysis of public junior high school students correlated between the first test and the second test using Pearson product moment analysis of 0.989. Based on the standard norm of the reliability coefficient according to Jimenez, et al. (2023, p. 269) the level of reliability of the Multistage Fitness Test to measure cardiorespiratory endurance is included in the high category. This proves that the level of cardiorespiratory endurance of public junior high school students when doing the Multistage Fitness Test has a high consistency because the results of the first and second implementation tests are not much different. Reliability refers to the ability of an assessment instrument to produce consistent results over time. ICC measures the extent to which test results can be consistent between different measurements, which in this case is the first test and the second test on the same learner. With an ICC reliability coefficient of 0.989, the Multistage Fitness Test can be reused on the same learners at different times without significantly changing the results. Thus, the Multistage Fitness Test has good constancy and can be used repeatedly to assess cardiorespiratory endurance with a low error rate. These results are in line with research conducted by Aertssen, et al. (2024) which proved that the 20m shuttle run test in children aged 6-12 years has a high validity of 0.78 and reliability using a good test- retest method of 0.84.

Based on the data from the Multistage Fitness Test test results to measure cardiorespiratory endurance, the average value (mean) is 31.76 and the standard deviation (SD) is 7.23. These results are then used to compile norm standards so that it can be known the level of cardiorespiratory endurance of each public junior high school student in the category of very good, good, MODERATE, bad, or very bad. From these results produced 5 ranges of norms, namely: ≥ 42.60 (very good); $35.37 \leq 42.6$ (good); $28.14 \leq 35.36$ (moderate), $20.91 \leq 28.13$ (bad); and ≤ 20.91 (very bad). Norm standards are criteria or limits used to classify

Validity Reliability and Standard Norm of Multistage Fitness Test for Measuring the Cardiorespiratory Endurance of the Junior High School Students Located in Kudus Regency

measurement results into certain categories based on the range of values that have been compiled. Norm standards are used to group test results based on the range of values that have been compiled in the table so that each learner can be grouped into the appropriate category based on their physical abilities.

Based on these norm standards, it can be seen that as many as 249 students 9% of them are in the very good category, 22% in the good category, 33% in the moderate category. 34% in the bad category, and 2% in the very bad category. From the results of these percentages it can be seen that the standard norm can be used as an assessment norm to measure the level of cardiorespiratory endurance of public junior high school students in Kudus Regency. This can be proven that 61% of students can do the Multistage Fitness Test in the very good (9%), good (22%), and moderate (33%) categories. The results of testing the Multistage Fitness Test norm category standards are in line with the opinion of Ngatman et al. (2020, p. 202) which states that the assessment norm is feasible to use as an assessment standard if $\geq 50\%$ of the subjects given the test have moderate / sufficient ability and above. From this opinion, the Multistage Fitness Test is still acceptable to use as a standard assessment norm to measure the level of cardiorespiratory endurance of public junior high school students in Kudus Regency.

IV. CONCLUSION

Based on the results of the research and the results of the data analysis that has been carried out, the following conclusions are obtained.

1. The results of the Multistage Fitness Test validity test based on the results of the analysis using Pearson correlation showed the result of - 0.990. The level of validity of the Multistage Fitness Test to measure the cardiorespiratory endurance of public junior high school students in Kudus Regency is included in the very high category. Thus it can be said that the Multistage Fitness Test is very valid to measure the cardiorespiratory endurance of public junior high school students in Kudus Regency.
2. Multistage Fitness Test reliability test results based on the results of the analysis using Pearson product moment correlation of 0.989. The level of reliability of the Multistage Fitness Test to measure the cardiorespiratory endurance of public junior high school students in Kudus Regency is included in the high category. Thus the Multistage Fitness Test is very reliable for measuring the cardiorespiratory endurance of public junior high school students in Kudus Regency.
3. Based on the test results, the average value and standard deviation are obtained, then the Multistage Fitness Test norm standards are arranged so that 5 norm ranges are produced, namely: (1) ≥ 42.60 (very good); (2) $35.37 \leq 42.6$ (good); (3) $28.14 \leq 35.36$ (moderate); (4) $20.91 \leq 28.13$ (bad); and (5) ≤ 20.91 (very bad). Thus each learner's test results can be included in one of the categories.
4. Based on the standard norms that have been compiled, the results of the student's cardiorespiratory endurance test can be known. The very good category is 9%, the good category is 22%, the moderate category is 33%, the bad category is 34%, and the very bad category is 2%. Thus it can be said that 61% of the cardiorespiratory endurance of public junior high school students in Kudus Regency is in the poor category.

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Validity Reliability and Standard Norm of Multistage Fitness Test for Measuring the Cardiorespiratory Endurance of the Junior High School Students Located in Kudus Regency

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