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Development of Junior Karate Physical Test Instruments in Kumite Category

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Abstract: The purpose of this study is to: (1) obtain effective test instruments for physiological, biomotor, and technical measurements in identifying the seeds of talented athletes in the sport of karate in the match (kumite) category, (2) produce the norms of physical tests for karate athletes to identify the seeds of talented athletes in the sport of karate, the match (kumite) category. Instrument development methods were used in the research. Affirmative factor analysis technique was employed to test empirical validity. This technique aims to justify the accuracy of test items that measure the dimensions of variables arranged based on theoretical constructs. Based on the research results, we formed ten indicators of the physical condition of karate athletes in the juveniles' kumite category, consisting of (1) sit and reach tests of 0.719 and 0.609; (2) ruler drop test of 0.674 and 0.540; (3) coordination tests (coordination of eyes, hands, and feet) of 0.809 and 0.712; (4) stork standing balance of 0.640 and 0.731; (5) triple hop jump of 0.801 and 0.749; (6) hexagon obstacle test of 0.608 and 0.608; (7) maximum speed test (30 meters sprint) of 0.817 and 0.740; (8) handgrip strength of 0.771 and 0.737; (9) muscle endurance tests (pushup) of 0.871 and 0.737; and (10) cardiorespiratory endurance tests (multi-stage running) of 0.799 and 0.814. The resulting product consists of a guidebook, test models, and physical test norms for karate in the kumite category.

Keywords: instrument development, karate, kumite.

组手类初级空手道体能测试仪的研制

摘要: 本研究的目的是（1）获得有效的生理、生物运动和技术测量测试仪器，以识别比赛（组手）类别空手道运动中的天才运动员的种子，（2）产生规范空手道运动员的体能测试，以确定空手道比赛（组手）类别中天才运动员的种子。研究中使用了仪器开发方法。采用肯定性因素分析技术来检验实证有效性。该技术旨在证明测量基于理论结构排列的变量维度的测试项目的准确性。根据研究结果，我们形成了青少年组手类空手道运动员身体状况的十项指标，包括（1）坐姿和伸展测试0.719 和 0.609； (2) 直尺跌落试验0.674 和 0.540；（3）协调性测试（眼、手、脚的协调性）0.809 和 0.712； (4) 鹳站立平衡0.640 和 0.731；(5) 的三跳 0.801 和 0.749； (6) 六边形障碍测试 0.608 和 0.608；（7）最大速度测试（30米冲刺）0.817 和 0.740； (8) 握力分别为 0.771 和 0.737；(9)肌肉耐力测试（俯卧撑）0.871 和 0.737； (10)的心肺耐力 0.799 和 0.814 测试（多阶段跑步）。最终产品包括空手道组手道的指南、测试模型和物理测试规范。

关键词: 乐器开发，空手道，组手。

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1. Introduction

The Karate is a type of body contact martial arts sport; karate is more related to high intensity when competing. In karate matches, according to the WKF (World Karate Federation) regulations in 2020, the 16-17-year-old group is categorized as junior, divided into two competing classes. The kumite class is a match for one fight, which is 2 (two) minutes for juniors (individuals) and 2 (two) minutes for juniors in the 2020 WKF (World Karate Federation) regulations. The numbers competed in the Kumite Junior are -55 kg, -61 kg, -68 kg, -76 kg, + 76 kg, while Kumite Junior, namely -48 kg, -53 kg, -59 kg, and + 59 kg. Karate is a high-level competitive sport that requires fast reactions [1].

The ability to understand information quickly and correctly simplifies decision-making and allows more time for the execution of the motor movements that a karate athlete needs to improve performance in competitions both in kumite and kata. Good reaction time is very important in karate because it is possible to identify the opponent's body movements early so that karate athletes can make attacks, defend or dodge during competition.

As a kind of sports enabling to achieve high results, karate requires a valid and reliable physical test to be used as a guide based on physical indicators so that it can improve the performance of karate athletes. Coaches should immediately recognize the importance of physical testing for athletes. The trainer can find out the athlete's physical condition only by carrying out a physical test, and it can be detected early if the athlete has a disturbance that will affect the athlete's performance or appearance during the competition. In addition, the results of the test can be used by the trainer as reference material for the preparation of training programs to improve karate achievement. This physical condition test will reflect the ability of each prospective athlete regarding their physical condition in the sport. Using a physical condition test, the coach can determine the level of the athlete's ability in the sport and make notes about the test results of prospective athletes in the sport of karate. In addition, this test can be used to diagnose weaknesses of athletes in the sport of karate so that it will be able to help in the next coaching process [2].

The results of the initial observations of researchers at the FORKI dojo South Sumatera, the training program focuses more on basic (kihon) training techniques and tactics, physical exercise has not been a priority in training, in terms of good physical condition is one of the requirements needed in every effort to improve athlete achievement, even it can be said that the basis of a starting point for sports achievement. Trainers who have done physical tests are still guided by general tests that are used to measure the physical condition of other sports, including squat thrusts, pull-ups, front jumps, hall squats, 300-meter run, zig-zag run, expanding strength, sit and reach, standing board jump, whole-body reaction. The coach in conducting the test should use a special test according to the branch. General physical tests are not necessarily suitable for the characteristics of karate athletes and have not yet tested how effective they are on the performance of karate athletes. The test should be relevant to the characteristics of karate athletes, reliable, and specific as a measuring tool, both individually and in teams. The test validity level shows the test user that the test can distinguish the characteristics of the player's physical abilities.

Currently, many types of general physical tests are used to identify and develop karate physical tests. However, it has not been tested for how effective they are on the performance of karate athletes. The selection of physical test elements is currently still based on theoretical logic that the test elements comply with the needs of karate athletes' physical abilities that have not been tested empirically. This is because the coach does not yet know the standard of tests and assessments intended for the karate athletes he coaches. The way to give the form of a physical test should be well structured so that when determining the standard, the athlete is said to be an athlete who is very good, good, not good, has the correct guidance. Types and test items must be adjusted to the characteristics of karate athletes. Another consideration is the difference in karate physical test items that the trainer carried out while training in their respective areas, as shown in Table 1.

Table 1 Karate physical test diversity (National KONI, SUMUT KONI, SUMSEL KONI, Bengkulu KONI, East Java KONI, SULSEL KONI)

No.	Test type by regions	Test items
1	National	1. Run 20 meter
		2. Shuttle Run (4x3 m)
		3. Shuttle Run (8x5 m)
		4. Split test
		5. Standing Broad Jump
		6. Push Up (1 minute)
		7. Sit Up (2 minutes)
		8. Sit Up with a Barbell
		9. Run 300 m
		10. Power Endurance (10 hops)
		11. Balke Test (general endurance)
		12. Beep Test
2	KO NI Speopleera Utara	A. LAB FISIK
		1. TB, BB (IMT)
		2. WBR (Visual) WBR (Audio)
		3. Speed Anticipation
		4. Agility (Site Step)
		5. Leg Strength
		6. Grip Strength
		7. Stork Balance Test
		B. L APANGAN
		8. Run 30 m
		9. Sit-Ups
		10. Pull-Ups
		11. Vertical Jump
		12. Flexibility
		13. Bleep Test
3	KO NI Sumatera	1. Multi-stage Running Test

	Selatan	2. Pushup 3. Sit-up 4. Pull up 5. Shuttle Run 6. Sit and Reach
4	Bengkulu	1. Vertical Jump 2. Sprint 50 meter 3. Sit and Reach 4. Multistage fitness test 5. Pushup 6. Sit and reach
5	KO NI Jawa East	1. 20-meter sprint 2. 3 RM Clean and Press 3. Triple jump (standing) 4. Single leg squat 5. Square Jump 6. Beep test 7. Sit and reach 8. Upper body Flexibility 9. Ankle Flexibility
6	KO NI Sulawesi Selatan	1. Hand Dynamometer 2. Push-Up 3. Run 50 meter 4. Medicine Ball 5. Balke Test 6. Pull up

Table 1 above shows the differences and similarities of the physical karate test items from each region. Unfortunately, the existing tests still overlap; this can be seen from two or more types of tests to measure the components of the same physical test. Knowing and understanding, and being able to carry out a sports skill test is very important for sports coaches. Therefore, when the standard of physical condition and the correct sequence of physical tests for karate athletes are known, it is hoped that they will provide good progress in physical condition before the karate athletes participate in matches and achieve optimal results.

2. Literature Overview

Singgih Hendarto [3] obtained ten indicators of the physical condition of karate athletes in the category of juveniles, including (1) sit and reach tests of 0.719 and 0.609; (2) ruler drop rest test of 0.674 and 0.540; (3) coordination test (eye coordination, hands, and feet) of 0.809 and 0.712; (4) stork standing balance of 0.640 and 0.731; (5) triple hop jump tests of 0.801 and 0.801 0.749; (6) hexagon obstacle test of 0.608 and 0.608; (7) maximum speed test (30 meters sprint) of 0.817 and 0.740; (8) handgrip strength tests of 0.771 and 0.737; (9) pushup of 0.871 and 0.737; and (10) cardiorespiratory endurance tests (multi-stage running) of 0.799 and 0.814. The resulting product is a guidebook, test model, and karate physical form test in the match (kumite) category. The conclusion of this study is a model of physical test karate in the kumite category suitable for karate athletes and advice for karate trainers; this physical test should be used at the time of selecting prospective karate athletes.

Didin Rosadi et al. [4] made software and hardware microcontroller-based pushup measuring instruments with ultrasonic sensors through the research and development (R&D) method approach. The trials were then conducted on 30 samples by undergoing pushup tests without sensors and using sensors with sound waves emitted by sensors called pings. The results continued that the test used more controlled sensors, and the movement was done better and correctly.

The results of Liskuistyawati's research showed two sets of table tennis tests for players aged 13-15 years, for checking arm span length, hand reaction speed, tennis ball capture test, 20m sprint, shuttle run, multi-stage run [5]. The analysis of the physical condition of junior table tennis players revealed that 87.55% of the results belong to the very high category. The conclusions of the research are (1) six items of table tennis physical tests suitable for players aged 13-15 years were produced; (2) the norms of physical tests for table tennis players aged 13-15 years were established; (3) six items of scales test were produced that are effectively used to improve the performance of table tennis players aged 13-15 years.

As a result of the application of training methods [6] the role of combined and complex motor skills was to identified and understood, especially for sports games throughout training and competition coupled with the motivation of maximizing athletic performance. Special technical preparation for each sports game and other unique elements of the game is the presence of game posts that require training tailored to specific demands. The role of coaching is to ensure methodical and psychological support.

Sports seeking individual skills in an organized selection, training, and competition system, aimed at improving sports results, achieving records and winnings is a widespread phenomenon, capable of increasing human energy and mobilization and material resources, finances that can be compared to other areas of social life, its evolution in recent decades, gradually turning it into a complex industry economic and social effects on human communities [7]. Organizations will enjoy a good image if they have a reputation based on their hierarchy of seniority or responsibility, competence, creativity, and performance rather than on evidence of employee devotion. Sports and sports management require social awareness and responsibility in theory, technique, style, and management methods. Understanding sports and sports management helps develop a healthy concept of responsible activities and decision-making.

The research by Göktepe & Aydoğan showed a significant difference in male and female athletes' physical and physiological parameter ratios, and cross-country skiers between the pairing parameters between body composition values showed significant differences [8]. The right-hand and left-hand grip power of male athletes also showed significant differences. In this context, it can be concluded that there are not many differences between similar sports

(long-distance running, individual sports, etc.) that use the same energy system in the body.

According to Mylsidayu [9], research instruments include (1) flexibility test with flexion of trunk-test, (2) limb power test with vertical jump test, (3) arm power test with two hand medicine ball put test, (4) agility test with shuttle run test, (5) speed test with sprint 50-meter test, (6) arm muscle strength test with hand dynamometer test, (7) limb muscle strength test with leg dynamometer test, (8) abdominal muscle endurance test with sit-up test, (9) arm muscle endurance test with pushup test, (10) back muscle endurance test with back lifts test, (11) limb tough endurance test with squat jumps test, and cardiorespiratory endurance test with beep test. The results showed that in Bekasi city in 2016, all martial arts athletes did not have the perfect physical condition; their category was very good for eight athletes (10.3%), 55 athletes (70.5%) had the good category, 15 athletes (19.2%) had satisfactory category.

3. Research Methods

This study uses the research and development (R&D) method [10], [11]. The subjects of this research and development of karate physical test are junior karate athletes (aged 16-17 years) who are active in dojo or karate college in South Sumatera, chronologically they trained at least two years with the frequency of training three times a week. This research data collection technique is qualitative data collection technique and quantitative data [12]. Qualitative data types are observations or observations, inputs, and suggestions from karate experts and trainers, while quantitative data results from the assessment of physical tests of junior karate athletes in the kumite category of South Sumatera.

This test instrument preparation technique is used as a reference to see what measurement tools are appropriate for athlete physical test karate junior category. The lattice instrument tests physical condition as follows:

Table 2 Instrument grid

Sub-variables	Indicator	Instrument test
Reaction speed	The state reacts with the movement to catch the object/ruler that is dropped.	1. *Hand reaction test*
Explosion power	1. Three jumps in centimeters. 2. The push is far from 3 times reset.	1. *Standing broad jump* 2. B*all medicine*
Muscle endurance	1. The ability to carry out a motion that supports the straightening of the arms and head, shoulders, back to the leg. 2. Ability to perform bedsit movements to the fullest.	*1. Pushup (1 minute)* *2.Shutup (1 minute)*
Cardiorespiratory endurance	Number of levels and shuttle	Run MT/beep test
Inclination	Flexibility testing and measurement and the trunk (stick)	1. *Sit and reach test* 2. *Shoulder flexibility*
Agility	1. The speed of motion jumping back and forth to six directions (hexagon) in three turns. 2. Fast speed in running alternating back and forth over a distance of 5 meters.	1. *Hexagon obstacle test.* 2. *Shuttle run*
Balance	The time the athlete maintains body balance in dynamic conditions.	*Modified Bass Test*
Coordination	The number of points increased when the ball hits the target.	Chord dear nation test hands and feet
Faster	The result of the 30-meter running travel time.	Run 30 meters

Once the instrument grid is arranged, the karate physical test instrument is arranged in tests and measurements.

4. Results and Discussion

Expert validation is a process to assess whether the initial product draft is worth testing or not in small or large groups. Therefore, the initial product of the roundhouse kick (mawashi geri) speed test instrument must be validated first by experts before being tested in small groups.

Table 3 Case processing summary

		N.	%
Cases	Valid	111	100.0
	Excluded	0	.0
	Total	111	100.0

Table 4 Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.973	.977	16

The value of *Cronbach's Alpha Based on Standardized Items* above obtained a value of 0.973 is found in the interpretation of correlation coefficients with intervals of 0.80 – 1,000 has a very strong level of reliability. Greater correlation coefficient value with r-table N-1= (111-1=110) or sample count of 110 with a level of 5% $\alpha = 0.05$ is 0.195 (r-count > r-table), then the data results of physical test items have a moderate level of reliability, or in other words, the test item result data can be continued at the large group trial stage. Requirements for determining the reliability of *Cronbach's alpha* test correlation value r_table of 135

respondents at the level of significance 5% α = 0.05 is 0.176 constructal reliability criteria (r_count >0.176=reliable and r_count < 0.176 = not reliable)*.

Furthermore, researchers used factor analysis to find out which test items were worth using or not worth using. In factor analysis (*factor analysis)* can be divided into two kinds of analysis of the main components (*principal component analysis = PCA)* and factor analysis (*FA*). The two analyses above aim to explain the structure of the variety model through a linear combination of the forming variables. Thus, it can be said that a factor or component is a form variable instead of a native variable. In general, factor analysis or analysis of the main components aims to reduce data and interpret it as a new variable. Process in factor analysis includes:

a. Determining variables to analyze

b. Testing predetermined variables using *Bartlett Test of Sphericity* method and MSA measurement (*Measure of Sampling Adequacy*).

c. Performing the core process, namely *factoring,* this process involves one or more factors of variables that have passed the previous variable test with *the Principal Component Analysis* method and *common factor analysis*

d. Performing the process of rotation of factors that have been formed using *Orthogonal Rotation* and Oblique *Rotation*

e. Interpreting the factors that have been formed, especially naming the factors formed, which is considered to represent the variables of the member of the factor.

Validation of the factor analysis results shows if the factor formed has been valid by a) dividing the initial sample into two parts and then comparing the results of one sample factor with the sample two, otherwise many differences can be said to be valid factors; b) by performing *confirmatory factor analysis* (CFA). The process of factor analysis is based on the matrix of correlation between the variables to obtain an analysis of factors that all variables must be correlated. Statistical tests are used to test accuracy in a factor model*; they are Bartlett's test sphericity* and *Kiser-Mayer-Olkin* (KMO) to determine the adequacy of the sample. Table 5 shows the results of the analysis of small group trial factors, *KMO, and Bartlett's test* analysis of physical factors for karate.

Table 5 KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.737
Approx. Chi-Square	650.043
Bartlett's Test of Sphericity Df	110
Sig.	.000

The magnitude of the correlation between the measured independent variables has a value between 0 and 1. Therefore, to state a strong relationship of the KMO-MSA numbers needed must be ≥ 0.5 with the opportunity value (Sig.) should < 0.05. This result indicates that the set of variables in this small group trial is significant and can be further processed. Furthermore, the data will be processed and processed by looking at the magnitude of the correlation between variables while including all variables. This detection is performed by looking at *the Anti Image Correlation,* which results in a Measure of Sampling *Adequacy* (MSA) value between 0 and 1. MSA = 1 variable can be predicted without error by other variables if MSA > 0.5 variables can still be predicted and analyzed further. Suppose the MSA < 0.5, then the variable must be eliminated and cannot be further analyzed or excluded from other sets of variables.

Small group trial results obtained *Kaiser-Meyer-Olkin measure of sampling adequacy* abbreviated KMO-MSA and *Bartlett's Test of Sphericity*. KMO-MSA test results against 22 variables tested obtained a value of 0.737 > 0.5 while *Bartlett's Test of Sphericity* figures showed *an Approximate Chi-square* figure of 650,043 with *a Degree of Freedom* (df) of 110 and significance of 0.000. The magnitude of the correlation between independent variables measured has a value between 0 and 1. To state a medium / somewhat good relationship, the KMO-MSA number must be above 0.5, and with an opportunity value (Sig.) must < 0.05. This result indicates that the set of variables in this small group trial is significant and can be further processed. In *the Anti Image tabulation matrices correlation*, one variable with an MSA value below 0.50 is a basketball throw of 0.304, which must be re-reduced and removed or eliminated because it is insignificant for advanced testing. For the trial of physical karate instruments, it is recommended to use 18 test instruments.

Table 6 Case processing summary

		N.	**%**
Cases	Valid	136	100.0
	Excluded[a]	0	.0
	Total	136	100.0

Table 7 Reliability statistics

Cronbach's Alpha[a]	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
.873	.877	16

The value of *Cronbach's Alpha Based on Standardized Items* above obtained a value of 0.873 is found in the interpretation of correlation coefficients with intervals of 0.80 – 1.000 with a moderate reliability level. The correlation coefficient value is greater with r-table N-1= (136-1=135) or sample count of 135 with a level of 5% α = 0.05 is 0.176 (r-count > r-table) then the data results of karate physical test items have a very strong reliability level, or in other words the test item result data can be continued at the large group trial stage.

The requirement to determine the reliability of *Cronbach's Alpha* test correlation value r_table of 135 respondents at a significance level of 5% α = 0.05 is

0.176 constructal reliability criteria (r_count >0.176=reliability and r_count < 0.176 = non-reliable)*.

Furthermore, researchers used factor analysis to find out which test items were worth using or not worth using. In factor analysis (*factor analysis)* can be divided into two kinds of analysis of the main components (*principal component analysis = PCA)* and factor analysis (*FA*). The two analyses above aim to explain the structure of the variety model through a linear combination of the forming variables. Thus, it can be said that a factor or component is a form variable instead of a native variable. In general, factor analysis or analysis of the main components aims to reduce data and interpret it as a new variable in a form variable.

Validation of the result of the factor to find out if the factor formed has been valid in a way: a). divide the initial sample into two parts and then compare the results of one sample factor with the sample two, otherwise many differences can be said to be valid factors; b) By performing *confirmatory factor analysis* (CFA) method. The process of factor analysis is based on the matrix of correlation between one variable and another to obtain an analysis of factors that all variables must be correlated. The results of the analysis of the small group trial, *KMO and Bartlett's test* analysis of physical karate factors are given in Table 8.

Table 8 KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.773
Approx. Chi-Square	706.700
Bartlett's Test of Sphericity Df	135
Sig.	.000

The magnitude of the correlation between the measured independent variables has a value between 0 and 1. To state a strong relationship, the KMO-MSA numbers needed must be ≥ 0.5, with the opportunity value (Sig.) should < 0.05. This result indicates that the set of variables in this small group trial is significant and can be further processed. Furthermore, the data will be processed and processed by looking at the magnitude of the correlation between variables while including all variables. This detection is performed by looking at *the Anti Image Correlation,* which results in a Measure of Sampling *Adequacy* (MSA) value between 0 and 1 if MSA = 1 variable can be predicted without error by other variables if MSA > 0.5 variables can still be predicted and can be analyzed further. Suppose the MSA < 0.5, then the variable must be eliminated and cannot be further analyzed or excluded from other sets of variables. Small group trial results obtained *Kaiser-Meyer-Olkin measure of sampling adequacy* abbreviated KMO-MSA and *Bartlett's Test of Sphericity*. KMO-MSA test results against 22 variables tested obtained a value of 0.673 > 0.5 while *Bartlett's Test of Sphericity* figures showed an *Approximate Chi-square* figure of 0.773 with *a Degree of Freedom* (df) of 135 and a significance of 0.000. The magnitude of the correlation between independent variables measured has a value between 0 to 1; to state a medium/somewhat good relationship, the KMO-MSA number must be above 0.5, and with an opportunity value (Sig.) must < 0.05.

Physical tests developed by paying attention to the substance test tailored to the character of karate athletes, for that the physical tests developed can be described on the table of physical test norms of karate athletes as follows:

Table 9 Norms of physical tests for karate athletes

Value	Number of Values	Classification
5	≥ 38	Excellent (BS)
4	35 – 37	Good (B)
3	32 – 34	Enough (C)
2	29 – 31	Less (K)
1	≤ 28	Less Once (KS)

5. Conclusion

Based on the research steps taken, and the data collected, as well as the analysis conducted, the conclusion of this study is a model of karate physical test for the competitive category (*kumite)* suitable for karate athletes, are as follows:

1) Sit and reach
2) Ruler drop test
3) Hand and foot-eye coordination
4) Standing stork balance
5) Triple hop jump
6) Hexagon obstacle test
7) 30m run
8) Strength hand grip
9) Pushup
10) Multi-stage running (MFT/ Beep Test)

The physical test model of karate in the competitive category *(kyorugi, sparring)* is effectively used for karate athletes. This effectiveness can be seen from the difference in pretest results before treatment and post-test after treatment. The difference between pretest and post-test shows that the average post-test value is higher than the average pretest value.

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