

ORIGINAL SCIENTIFIC PAPER

Innovation, Validity, and Reliability of Modified Dynamic Balance Test for Karate Kata Category

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Abstract

This study aims to create innovation through validity and reliability tests in the form of modification of dynamic balance test to meet the needs of karate athletes in kata category. The sample as a validation test was 11 experts from certified lecturers and coaches. Then, the sample as a reliability test was 50 male athletes with 10.5 ± 8.3 years of karate training experience and 8.3 ± 5.2 years of experience in the kata category, and 50 female athletes with 8.7 ± 9.6 years of karate training experience and 7.7 ± 8.4 years of experience in the kata category. The results of this study included seven aspects which were the suitability of the definition of balance to the test media, the suitability of the test specifically for the kata category, the appearance or design of images that are easy to understand, the test procedure that is easy to do, the distance at each cone, the ease to organize test, then validity value of Aiken $V > 0.8$, reliability value of Cronbach's Alpha 0.778 and ICC value 0.777, the results of the male and female athlete questionnaires through independent t-test ($p < 0.05$) of 0.366. In conclusion, the Modified Dynamic Balance Test developed for the Karate Kata category has a high level of validity and reliability in the various aspects tested. The absence of differences in the results between male and female athletes confirms that the test is fair and applicable to all athletes, and it makes the test a proper test tool for improving performance in competition.

Keywords: dynamic balance, karate test, measuring instrument innovation

Introduction

Dynamic balance is one of the fundamental components of athletic performance, especially in karate, which demands precise, fast, and varied movements. Dynamic balance is essential in karate because it helps athletes maintain stability when performing complex movements, improve movement efficiency, and maintain correct posture (Pinto-Escalona et al., 2024). Good balance allows athletes to perform techniques with precision, power, and speed without losing control in order to give them an edge in the competition (Mijatović et al., 2023). In the Kata category in karate, dynamic balance is vital in maintaining stability during transitions between movements and correct posture when performing complex techniques. Good balance improves movement efficiency and

reduces the risk of injury when performing explosive movements (Kokic et al., 2022).

The balance ability of athletes can be known through balance tests. Balance tests are essential to identify the athlete's level of balance, evaluate the training program's effectiveness, and adjust the training to suit the athlete's specific needs better (Oktavian et al., 2022). In addition, the balance test results can also help design better training strategies and detect potential weaknesses that can interfere with athlete performance (Almas et al., 2023). To date, dynamic balance tests are often performed for athletes such as the Y-Balance Test and Star Excursion Balance Test (Ahern et al., 2021; Picot et al., 2021; Plisky et al., 2021; Ribnikar et al., 2024). Coaches often use balance tests such as Y-Balance Test and



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Star Excursion Balance Test because they effectively measure an athlete's dynamic balance, essential for maintaining body stability during multi-directional movements. These tests help identify asymmetries or weaknesses that could increase the risk of injury and allow coaches to evaluate training progress by comparing results over time (Ahern et al., 2021). In addition, the test is relatively simple and does not require expensive equipment, but provides accurate data on the functional balance of the athlete, making it very useful in optimizing performance and preventing injuries (Plisky et al., 2021; Ribnikar et al., 2024).

Although some balance tests are already designed to measure dynamic balance ability, most of them are vague to the characteristics and needs of karate athletes, particularly in the Kata category. Previous research investigated a balance test on karate using a modified bass test of dynamic balance (Almas et al., 2023; Oktavian et al., 2022), then another research explored the use of Y-balance test to measure balance (Ben Hassen et al., 2022; Pekel et al., 2023). In the results of the novelty study, it was also found that Star Excursion Balance Test was also used for testing balance of karate athletes aged 18-22 (Kindzer et al., 2024), Moreover, the latest study investigated the use of the Stork Standing balance model for karate athletes aged 16-17 (Purba et al., 2024). However, some research results for balance tests are still limited to general fitness tests for the Kumite and Kata categories. Therefore, a more precise and appropriate test is needed to evaluate the dynamic balance of karate athletes in the kata category.

This study aims to develop a modified existing dynamic balance test, adapted specifically to meet the needs of karate athletes in the Kata category. The importance of the results of this study is that it can provide broad insight to coaches and academics in the sport of Karate (Widyastuti

et al., 2024). In addition, this study will also evaluate the validity and reliability of the modified test to ensure that it can be used as a reliable and accurate measuring tool in the context of karate sports. This development is expected to improve the quality of training and performance evaluation of karate athletes and prevent injuries related to dynamic balance.

Method

Procedures

This research used quantitative and qualitative approaches. A mixed methods approach is needed to develop measurement tools in innovation research to obtain more profound and measurable study results (Susiono et al., 2024). The first stage in this study was to review articles in English with the topic 'kata' or 'karate' or 'dynamic balance', as well as field observations. The purpose of this stage was to collect material about the physical component of balance so that it can design a form of balance test. The results of the first stage, showed that the karate kata's dynamic balance is the body's ability to remain standing and not fall when changing the direction of each movement or when performing high-speed movements. Then innovations for the testing were made based on the results of other research (Aisyah et al., 2020; Emad et al., 2020; Gawel & Zwierzchowska, 2024; Guler et al., 2017; Molinaro et al., 2020; Pal et al., 2021; Przybylski et al., 2021; Zago et al., 2015).

After the materials were collected, the second stage was to design a dynamic balance test (Figure 1). The equipment for this test was 1) a large mattress, 2) five cones, 3) a whistle, and 4) a stopwatch. Then, three examiners were needed, with their respective duties: one as an instructor, one as a stopwatch holder, and one as a recorder and reporter of test results.

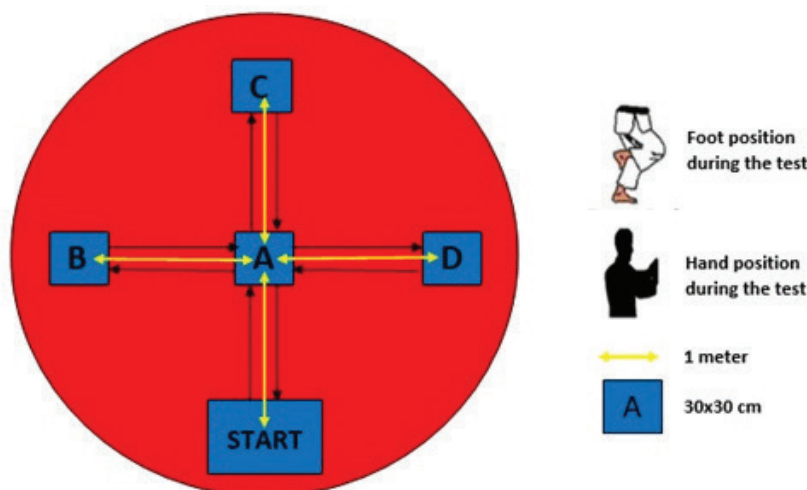


FIGURE 1. Dynamic Balance Test Design

The procedure for this test innovation that must be done by the athlete was as follows: 1) Testee stands with two feet in the Start Position; 2) When the Tester gives the command "Start", Testee steps to Position A with the right foot and maintains the Position for five seconds which is counted by the Tester; 3) From Position A, Testee steps to Position B with the left foot and maintains the position for five seconds; 4) From Position B, Testee steps back to Position A with Right foot as support and maintains position for five seconds; 5) From Position A, Testee steps to Position C with left foot as support and main-

tains position for five seconds; 6) From Position C, Testee steps back to Position A with Right foot as support and maintains position for five seconds; 7) From Position A, Testee steps to Position D with left foot as support and maintains position for five seconds; 8) From Position D, Testee steps back to Position A with Right foot as support and maintains position for five seconds; 9) From Position A, Testee steps back to the START line with both feet as support; 10) The total time of the test is the time to maintain the body in each position plus one second for locking each position, which is, 42 seconds. The ath-

lete performed three attempts, and the best time of the three attempts was recorded.

After the design, required equipment, and test execution procedures had been determined, the third stage was to conduct validity and reliability tests. The validity test was carried out by academics in sports coaching with a background as karate coaches and karate coaches with a minimum national-level trainer certificate. The Delphi technique was applied to this validity test.

Experienced karate athletes carried out the reliability test in the kata category. Athletes were asked to perform a motor test in the form of balance which had previously been declared valid, then the results were analyzed statistically to determine the reliability of the test.

The validity and reliability test assessment used a questionnaire consisting of seven aspects, and interviews were not structured if needed. The assessment aspect consists of 1) aspects of the suitability of the definition of balance to the test media, 2) aspects of the suitability of the test specific to the Kata category, 3) aspects of the appearance or design of images that are easy to understand, 4) aspects of the test procedure that are easy to do, 5) aspects of the distance on each cone, 6) aspects of the ease of conducting this test at anytime and anywhere.

Participants

The sample of this study involved 11 experts as validators, consisting of four experts from sports coaching education lecturers who are doctoral degree qualified and have karate expertise. Then, seven karate practitioners or trainers already have a national minimum trainer certificate and a bachelor's degree in sports. The 11 validators were identified as having belt of DAN IV-VI levels. This study involved 100 karate athletes (50 male and 50 female) in the Kata category aged

17-23 as a sample for the reliability test. The selection of this sample used purposive sampling, then the athletes also voluntarily became respondents with written consent. Thus, the athletes who were sampled were in the category of having at least been champions in competitions at the provincial level. Sample characteristics in male athletes were as follows: height (mean±SD) 166.43±7.7 cm; weight 67.3±0.3 kg; karate training experience 10.5±8.3 years; experience in the kata category 8.3±5.2 years. The characteristics of the sample in female athletes were as follow: height (mean±SD) 161.6.8 ±3.6 cm, weight 54.6±3.1 kg, karate training experience 8.7±9.6 years, experience in the kata category 7.7±8.4 years. This research has also received ethical approval from the institution 003/S. IP/IKS-UNY-UNRI/A.III/II/2024.

Statistical Analysis

Several tests were conducted to analyze the data in this study. The validity test used the Aiken formula (Aiken, 1985). Then, the reliability test used Cronbach's Alpha and Intraclass Correlation Coefficients (ICC). The significant value reference used in this study was Cronbach's Alpha, which was >0.7, meaning that the innovation of this test has acceptable reliability (Amirrudin et al., 2020). Then, the reference of significance value of Intraclass Correlation Coefficients (ICC) was found between 0.75-0.9 or >0.9, meaning that it has good reliability (Koo & Li, 2016). After the reliability test was carried out on the athlete sample, an independent t-test was conducted on the male and female samples. The independent sample t-test aimed to analyze whether there were differences in assessment between male and female athletes. Analysis of reliability test data and independent sample t-test using SPSS 26 software (George & Mallery, 2019). The scale for the assessment of this test is 1-4,, 1 being 'strongly disagree', 2 being 'disagree', 3 being 'agree', 4 being 'strongly agree'. Level of significance was set at 0.05.

$$V \text{ Aiken's: } \frac{\sum S}{n(c-1)}$$

S : r - lo
 Lo : lowest rating score
 C : highest rating score
 r : the score given by the assessor

FIGURE 2. Aiken V Validity Formula

Results

The analysis of the results of this study consists of three stages, the first stage is a validity test conducted by nationally certified karate lecturers and trainers. The second stage is a reliability test conducted by athletes by trying this test innovation. The third stage is an independent t-test by comparing the results of the balance test assessment based on gender in this sample.

Validity Test

The first stage is reporting the results of the validity test in table 1 below, which was carried out by 4 doctoral lecturers who have karate trainer expertise and 7 karate trainers who have national trainer certificates. So that the 12 validators will assess six aspects of the indicators in this balance test innovation.

Table 1. Aiken V Validity Test Results

Aspects	ΣS	n(c-1)	Aiken	Description
Suitability of balance definition to test media	28	33	0.848	Valid
Suitability test specific to the Kata category	27	33	0.818	Valid
Easy-to-understand image display or design	28	33	0.848	Valid
Easy test procedure	28	33	0.848	Valid
Distance on each cone	29	33	0.879	Valid
Ease of conducting the test at anytime and anywhere	27	33	0.818	Valid

Based on the results of the Aiken validity test in Table 1, aspect 1), namely the suitability of the definition of balance to the test media was the value of V 0.848, aspect 2), namely the suitability of the test specifically for the kata category was the value of V 0.818, aspect 3). Namely, the appearance or design of images that are easy to understand was the value of V 0.848, aspect 4), namely the easy test procedure was the value of V 0.488, aspect 5), namely the distance at each cone was the value of V 0.879, aspect 6), namely the ease of conducting the test at anytime and anywhere was the value of V 0.818. Therefore, the validity test results based on the seven aspects showed that the Aiken value of $V > 0.8$, which means that the aspects are declared valid (Aiken, 1985).

Reliability Test

The second stage is a reliability test conducted by 50 male athletes and 50 female athletes. This reliability test is, athletes will do a motor test in the form of balance. After the athletes try this innovative form of the test, the athletes are asked to assess six aspects. After the athletes assess, these results will be tested through Cronbach's Alpha and Interclass Correlation Coefficient.

Based on the results in Table 2 below, the value of Cronbach's Alpha for Dynamic Balance Test Modification for Karate Kata was 0.778. The agility test was reliable because it had a Cronbach's Alpha value of > 0.7 .

Table 2. Cronbach's Alpha Results

Reliability Statistics	
Cronbach's Alpha	N of Items
0.778	6

Based on the results in Table 3 below, the Interclass Correlation Coefficient (ICC) value for the Modified Dynamic Balance Test for the Karate Kata Category, had the value of $r = 0.777$ and had a value of 95% confidence interval (CI) be-

tween 0.640–0.807, meaning that this test innovation also has good reliability in addition to Cronbach's Alpha value so that the Modified Dynamic Balance Test can be used to measure and analyze balance for karate kata athletes.

Table 3. Interclass Correlation Coefficient Results

	Intraclass Correlation ^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	0.346 ^a	0.387	0.611	36.882	99	255	0.001
Average Measures	0.777 ^c	0.640	0.807	36.882	99	255	0.001

Based on the results of table 2 and table 3 above, the Cronbach's Alpha results show 0.778 and the Interclass Correlation Coefficient results show 0.777. Thus, the results of the reliability test are that the balance test innovation for athletes in the word category is reliable.

The assumption of normality test was also used through Kolmogorov-Smirnov ($p > 0.05$). This normality test showed sig. 0.066 in male athletes and sig. 0.059 in female athletes. Thus, it is feasible to continue the independent t-test because the data is normal distributed.

Independent T-Test

The independent t-test compared the answers of 50 male and 50 female athletes is shown in table 4 below. This assessment was based on the results of the answers from the reliability test that the kata category athletes must answer.

Based on the results in Table 4 above, the value of sig. showed 0.366, meaning that there is no difference in answers from the questionnaire results between male and female athletes in Karate Kata. Thus, the athlete in the Kata category, supports creating an innovation in the Modification of Dynamic Balance Test for Karate in the Kata category.

Table 4. Independent T-Test Results

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Assessment of Modified Dynamic Balance Test for Karate Kata	Equal variances assumed	0.907	98	0.366	0.400	0.441	-0.475	1.275
	Equal variances not assumed	0.907	97.827	0.366	0.400	0.441	-0.475	1.275

Discussion

Based on the results of this study, the Modified Dynamic Balance Test for Karate Kata has high validity and good reliability. The suitability of the definition of balance to the test media shows that the definition of balance is based on the modified test's form and purpose. Movement balance in Kata requires high body control, both in static and dynamic positions (Younesi et al., 2022). When athletes perform the Kata movement, the athlete must be able to maintain a stable and

correct posture while performing various techniques such as kicks, punches, and body position changes (Katanic et al., 2022). The answer or response of the athlete also explains that the movement when performing Kata requires a smooth and controlled weight transfer from one position to another. The athlete also stated that this test modification is more acceptable than other balance tests, such as the standing stork, flamingo, and Y balance tests. This modification requires athletes to move and step with stance (dachi) compared to previous

tests. The next aspect of the suitability of specific tests for the Kata category is that they also have a high level of validity and good reliability, which indicates that the modified test has been adjusted to the specific needs of Karate Kata. It is essential because movements in Kata have unique characteristics that require different dynamic balance compared to other sports, such as moving around with a combination of punch movements, fast kicks, then stopping suddenly but with sturdy stance (dachi) or with a balanced body (Yudhistira et al., 2021). With good balance, an athlete may maintain stability while moving, which can reduce the effectiveness of the technique to the detriment of overall performance.

Aspects of the display or image design that test takers easily understand indicate that the visual representation of the test has been well designed, facilitating the athlete's understanding and implementation of the test. In this case, the high level of validity indicates that the image's design supports the implementation of the test in the right way. At the same time, good reliability signifies that this design is reliable in various conditions and by various participants (Navalta et al., 2023). Easy-to-understand drawing design is essential when developing or modifying test forms. It ensures that all users, including athletes, coaches, and evaluators, can quickly follow test instructions and procedures without worrying about confusion. Thus, it will have an impact on the procedural aspects of the test. The results show that the procedural aspects of the test, such as language that is easy to understand and the steps to start and end the test, have a high level of validity and good reliability which confirms that the test developed is not only effective but also practical. It also helps to maintain the accuracy of test results, as all test takers will follow the same procedure with uniform interpretation (Adamakis, 2022). Most of the samples in this study stated that they could easily understand the procedures of this procedure just by looking at the design and reading the implementation procedures. Coaches and athletes also argue that this test can be applied to novice athletes or athletes not from karate because of practicality.

This assessment also corrects the distance aspect of each cone, the results of which have high validity and good reliability, indicating that the spatial arrangement in the test has been optimally arranged to measure dynamic balance. It is important because the distance when the athlete moves can affect the athlete's ability to maintain balance while performing movements similar to those in the Kata competition (Sastra et al., 2022). Trainers and athletes also explained that the distance of each cone along one meter is determined by the stance shape (dachi), where the distance between two feet is one meter. The distance has shown a situation where the athlete must move in various directions with high balance control (Daker et al., 2023). Athletes who move to each cone and stand on one leg for five seconds test their ability to maintain balance after changes in direction and position, which are essential elements in Kata movements. In Karate Kata, athletes often have to stop their movements abruptly and hold certain positions with perfect stability (Elkess et al., 2023).

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Conflict of Interest

The researchers have no conflicts both with the researchers and the results of other studies.

Then, the ease of implementation of this test shows high validity and good reliability, highlighting that this test is practical. The ease of conducting this test is related to several practical factors that make this test very efficient and easy to implement. First, this test does not require high costs, so that various groups can access it without a significant financial burden. Second, the test requires only three people as testers, so the management does not require a lot of human resources, making it simpler and easier to manage. In addition, this test requires little space, so that it can be carried out in various locations such as gyms, school halls, or even outdoors with limited areas. Finally, because this test does not require advanced technology, special equipment, or electronic devices, it further increases the ease of its implementation. This simplicity that has been valid and tested allows the test to be carried out more flexibly and can be widely applied (Purba et al., 2024).

The results and discussion of this study show that the Modified Dynamic Balance Test developed for the Karate Kata category has a high level of validity and reliability in the various aspects tested. The absence of differences in answers from the questionnaire results between male and female athletes shows that this test is fair and can be applied to all athletes regardless of gender. It also supports the fact that athletes have received this innovation in the Modified Dynamic Balance Test, which is relevant for various groups of athletes. The limitation of this study is that specialist karate lecturers and coaches of kata are still very rare in Indonesia, of course it will affect the perspective as an expert in assessing. Then the testing conducted on athletes was done with one trial so that re-testing could not be done. Thus, these tests can be widely adopted in the training and Evaluation of athletes to improve their performance in competitions.

Conclusion

In conclusion, the Modified Dynamic Balance Test developed for the Karate Kata category has a high level of validity and reliability in the various aspects tested. The definition of balance used is based on the test's purpose, which is essential in Kata movements that require heightened body control. This test's good validity and reliability indicate that it fits the specific needs of the Kata category, including the ability to maintain stability and control during complex dynamic movements. The visual design and easy-to-understand test execution procedures support uniform and accurate execution, even by athletes and coaches with diverse backgrounds. The optimal inter-cone spacing helps to simulate the equilibrium conditions encountered in the Kata competition. This practical test does not require high costs, ample space, or advanced technology to be easily implemented in various locations. The absence of differences in the results between male and female athletes confirms that the test is fair and applicable to all athletes. The results of this study explain that this test has proven to be effective and reliable as a dynamic balance measuring tool specific to Karate Kata athletes, making it a valuable tool to improve performance in competition.

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