REVIEW ARTICLE

Models of anaerobic endurance measurement tests in combat sport: literature review

Trisnar Adi Prabowo[ABCDE], Asyidika Vito Indarto[AB], Mar'atul Afifah[BC], Febriansyah Dwi Cahyo[DE], Zakwan Yumna Dhuha Pahlavi[AE], Achmad Zakaria[BE]

Physical Education Study, Universitas Muhammadiyah Brebes, Indonesia

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim: Combat sports require athletes to perform repetitive, high-intensity movements, such as kicks, punches, throws, grappling, body control, and rapid movement transitions under conditions of fatigue. These demands make anaerobic endurance, anaerobic capacity, anaerobic strength, and fatigue resistance critical components of martial arts performance. However, measuring anaerobic capacity in martial arts is complex because each sport has different movement patterns, energy requirements, technical characteristics, and competition structures. This study aimed to identify and analyze anaerobic endurance measurement models used in martial arts through a literature review.

Material and Methods: This study used a literature review design with the PRISMA method. Articles were searched through Google Scholar, Scopus, PubMed, ScienceDirect, SpringerLink, Taylor & Francis Online, DOAJ, Garuda, and SINTA. The search was limited to articles published between January 2011 and April 2026. The article selection process followed the PRISMA procedure, including identification, removal of duplicates, screening of titles and abstracts, assessment of full-text eligibility, and final article selection. Of the 762 articles identified at the initial stage, 10 primary articles met the inclusion criteria and were analyzed using narrative synthesis.

Results: The analyzed articles covered taekwondo, kickboxing, mixed martial arts, karate, Brazilian jiu-jitsu, boxing, wrestling, general combat sports, and pencak silat. The identified testing models can be grouped into sport-specific tests, laboratory tests, general field tests, and fatigue index-based tests. Sport-specific tests include the Taekwondo Anaerobic Intermittent Kick Test, the Taekwondo-specific Aerobic-Anaerobic-Agility Test, the Kickboxing Anaerobic Speed Test, the MMA-Specific Anaerobic Assessment, and the Jiu-Jitsu-Specific Performance Test. General laboratory and field tests include the Wingate Anaerobic Test, the 30-second Continuous Jump Test, the Running-based Anaerobic Sprint Test, and fatigue index measurements. Some studies reported evidence of validity and reliability, whereas others used anaerobic tests primarily to profile athlete abilities.

Conclusions: Anaerobic endurance measurements in combat sports need to be selected based on the specific characteristics of each discipline. Discipline-specific tests are more relevant for evaluating performance patterns that mimic the demands of competition. Laboratory and general field tests remain useful for physiological profiling and practical field measurements. In the context of pencak silat, anaerobic endurance measurements are still dominated by general field tests and fatigue indices. Future research should develop and test more specific, valid, reliable, and practical anaerobic endurance tests for pencak silat and other martial arts or combat sports.

Keywords: martial arts, combat sport, anaerobic endurance, sport-specific tests, athlete performance

Introduction

Combat sports are complex disciplines that require the integration of physical, technical, tactical, and psychological abilities in dynamic match situations. Athletes in combat sports are required not only to possess strength, speed, power, agility, and endurance, but also to apply technical skills such as punches, kicks, throws, locks, dodges, and rapid, precise body position changes [1, 2, 3]. This complexity can be observed in various sports, such as taekwondo, karate, boxing, kickboxing, wrestling, judo, pencak silat, Brazilian jiu-jitsu, and mixed martial arts. These sports have different movement characteristics, but all require repeated high-intensity performance [4]. Other studies have also shown that measuring physical performance needs to take into account the specific characteristics of the sport because the physiological responses and movement demands of each martial art are not always the same [5].

One of the most important physiological components in martial arts is the anaerobic energy system. In combat sports, athletes frequently perform short, explosive movements, such as punch combinations, rapid kicks, repeated strikes, pushes, pulls, throws, or high-intensity positional

doi:10.15561/physcult.2026.0204

transitions [6]. These activities rely heavily on anaerobic capacity, especially when athletes must maintain intensity despite fatigue. Studies involving combat athletes have shown that the 30-second Wingate test can be used to describe the contribution of the energy system during maximal activity, both in single movements and in intermittent bursts of movement [4]. In addition, research on young boxers has also shown the importance of measuring anaerobic performance through various maximal tests [7]. These tests include Wingate cycling, arm cranking, punching bag tests, and uphill running to understand the physiological profile of athletes [5].

The need for precise and specific measurement tests is crucial because the results of physical tests are used by coaches to evaluate athlete condition, develop training programs, monitor training adaptations, and determine readiness to compete [8]. Measuring anaerobic endurance in combat sports is not sufficient when using only general tests because each discipline has different movement patterns, action durations, rest intervals, and body part dominance [9, 10]. A good test should have clear procedures, interpretable outcome indicators, and evidence of validity and reliability. For example, the Taekwondo Anaerobic Intermittent Kicking Test was developed to assess anaerobic capacity through specific taekwondo kicking movements. It was also compared with the Wingate Anaerobic Test as a laboratory benchmark [11]. This finding shows that specific tests are needed for each sport so that the measurement results more closely reflect the actual performance demands of martial arts athletes.

Various testing models have been used to measure anaerobic capacity in martial arts. Laboratory tests, such as the Wingate Anaerobic Test, remain widely used because they provide indicators such as peak power, average power, and fatigue index [5]. In addition, several field tests and sport-specific tests have been developed, such as the Taekwondo Anaerobic Intermittent Kick Test, the Kickboxing Anaerobic Speed Test, the Mixed Martial Arts Specific Anaerobic Assessment, the Jiu-Jitsu Specific Performance Test, the Running-based Anaerobic Sprint Test, and punching- or kicking-based tests [12]. Research on kickboxing has shown that the Anaerobic Kickboxing Speed Test has good test-retest reliability and discriminatory validity for differentiating athlete levels [13]. Meanwhile, research on mixed martial arts has shown that MMA-specific anaerobic tests correlate with anaerobic capacity and can be used to assess an athlete's anaerobic profile more specifically [14].

Analysis of research findings has shown that anaerobic endurance is a physiological component in combat sports and that its assessment requires approaches adapted to the specific characteristics of each discipline. Researchers emphasize that laboratory tests, general field tests, and sport-specific tests provide different types of information related to anaerobic performance, fatigue resistance, and physiological profiling of athletes. Authors also highlight the need to use valid and reliable testing procedures that reflect the actual movement patterns and competition demands of combat sports. At the same time, the diversity of testing models and the variation in sport-specific characteristics continue to create challenges in selecting the most appropriate methods for evaluating anaerobic endurance in martial arts. This issue continues to limit the development of more standardized and practically applicable approaches for assessing anaerobic endurance across different combat sport disciplines.

In this context, although various anaerobic testing models have been used in martial arts research, the available information remains scattered across disciplines, test types, and research contexts. Some studies focus on the validity and reliability of the tests, whereas others use them solely to describe physical condition profiles or evaluate the outcomes of training interventions. Therefore, a literature review is needed to synthesize anaerobic endurance testing models used in martial arts, with attention to test types, measurement procedures, outcome indicators, validity, reliability, practicality, and suitability to the characteristics of each discipline.

Based on the description above, this study aimed to identify and analyze anaerobic endurance measurement test models used in martial arts through a systematic literature review approach. This review focused on primary research articles discussing the testing or measurement of anaerobic endurance, anaerobic capacity, anaerobic power, fatigue index, or repeated high-intensity performance in athletes or martial arts practitioners. The results of this study are expected to provide an overview of the testing models that have been used, the characteristics of the implementation procedures, outcome indicators, as well as the strengths and limitations of each test. In addition, the findings of this review are expected to provide a scientific basis for coaches, researchers, and sports practitioners when selecting a more appropriate, practical, and relevant testing model to evaluate the anaerobic abilities of martial arts athletes.

Materials and Methods

Study Organization

This study used a literature review design with the PRISMA method to identify, select, analyze, and synthesize primary research articles [15] discussing anaerobic endurance measurement test models in

combat sports. A literature review approach was chosen because it is suitable for mapping various types of tests used in previous research, comparing the characteristics of measurement procedures, and evaluating the relevance of sport-based tests, outcome indicators, validity, reliability, and practicality in the context of martial arts training. The process of searching for and selecting articles was carried out systematically through several stages, namely article identification, elimination of duplicates, screening of titles and abstracts, assessment of full-text eligibility, and determination of the final articles for analysis.

Data Sources and Search Strategy

The article search was conducted through several scientific databases, namely Google Scholar, Scopus, PubMed, ScienceDirect, SpringerLink, Taylor & Francis, Garuda, and SINTA. The selection of these databases aimed to obtain international and national articles relevant to the fields of sports science, sports training, exercise physiology, and martial arts. The article search was limited to publications published between January 2011 and April 2026. The 15-year time span was chosen to obtain a sufficiently broad scope of evidence while maintaining the relevance of developments in anaerobic endurance measurement tests in modern sports training practices.

The keywords used in the article search process were compiled using a combination of terms related to anaerobic capacity, measurement tests, and martial arts. The main keywords used included: "anaerobic endurance", "anaerobic capacity", "anaerobic power", "anaerobic performance", "fatigue index", "repeated sprint ability", "anaerobic test", "anaerobic assessment", "sport-specific test", "combat sports", "martial arts", "judo", "karate", "taekwondo", "boxing", "kickboxing", "wrestling", "pencak silat", "Brazilian jiu-jitsu", and "mixed martial arts". These keywords were combined using the Boolean operators AND and OR to broaden and narrow the search results.

In addition, searches were conducted based on the names of specific tests frequently used in martial arts, such as the "Wingate Anaerobic Test", "Running-based Anaerobic Sprint Test", "Special Judo Fitness Test", "Frequency Speed of Kick Test", "Taekwondo Anaerobic Intermittent Kick Test", "Kickboxing Anaerobic Speed Test", "Jiu-Jitsu-Specific Performance Test", and "MMA-specific anaerobic test".

Inclusion and Exclusion Criteria

The inclusion criteria in this study were established to ensure that the analyzed articles met the objectives of the systematic literature review. Articles were included in the analysis if they met the following criteria:

1) the article was primary research;

2) the article was published between 2011 and 2026;

3) the article was written in English or Indonesian;

4) the research subjects were athletes, practitioners, or martial arts participants;

5) the article discussed the measurement of anaerobic endurance, anaerobic capacity, anaerobic power, fatigue index, or repeated high-intensity performance;

6) the article included the name of the test, the implementation procedure, and at least one measurement outcome indicator;

7) the article was available in full text.

The exclusion criteria in this study included:

1. articles with a literature review, systematic review, scoping review, narrative review, or meta-analysis design;
2. articles in the form of editorials, letters to the editor, popular articles, undergraduate theses, dissertations, or non-scientific documents;
3. articles that did not discuss martial arts;
4. articles that did not discuss anaerobic capacity or high-intensity performance indicators;
5. articles that only discussed exercise interventions without adequately explaining the tests or measurement procedures;
6. articles that were not available in full text; and
7. articles written in languages other than English and Indonesian.

Articles using review methods were not included in the main analysis to avoid duplication of evidence and the risk of double-counting primary articles synthesized in previous reviews. However, relevant review articles were used as supporting references in the introduction and discussion to strengthen the conceptual foundation, research urgency, and identification of research gaps.

Therefore, 524 articles were identified during the identification stage. After 117 duplicate articles were removed, 407 articles remained for screening. Based on the title and abstract selection, 356 articles were excluded because they did not match the research topic. A total of 51 articles were read in full, and 31 articles were excluded for not meeting the inclusion criteria. Thus, 20 articles were included in the final analysis. Figure 1 presents the literature review procedure used in this study.

Results

Based on the article selection process, 10 primary research articles met the inclusion criteria and were analyzed in this systematic literature review. The selected articles discussed testing models used to measure anaerobic endurance, anaerobic capacity, anaerobic power, fatigue index, or repeated high-intensity performance in martial arts. The sports discussed in the articles included taekwondo, kickboxing, mixed martial arts, karate, Brazilian jiu-jitsu, boxing, wrestling, general martial arts, and

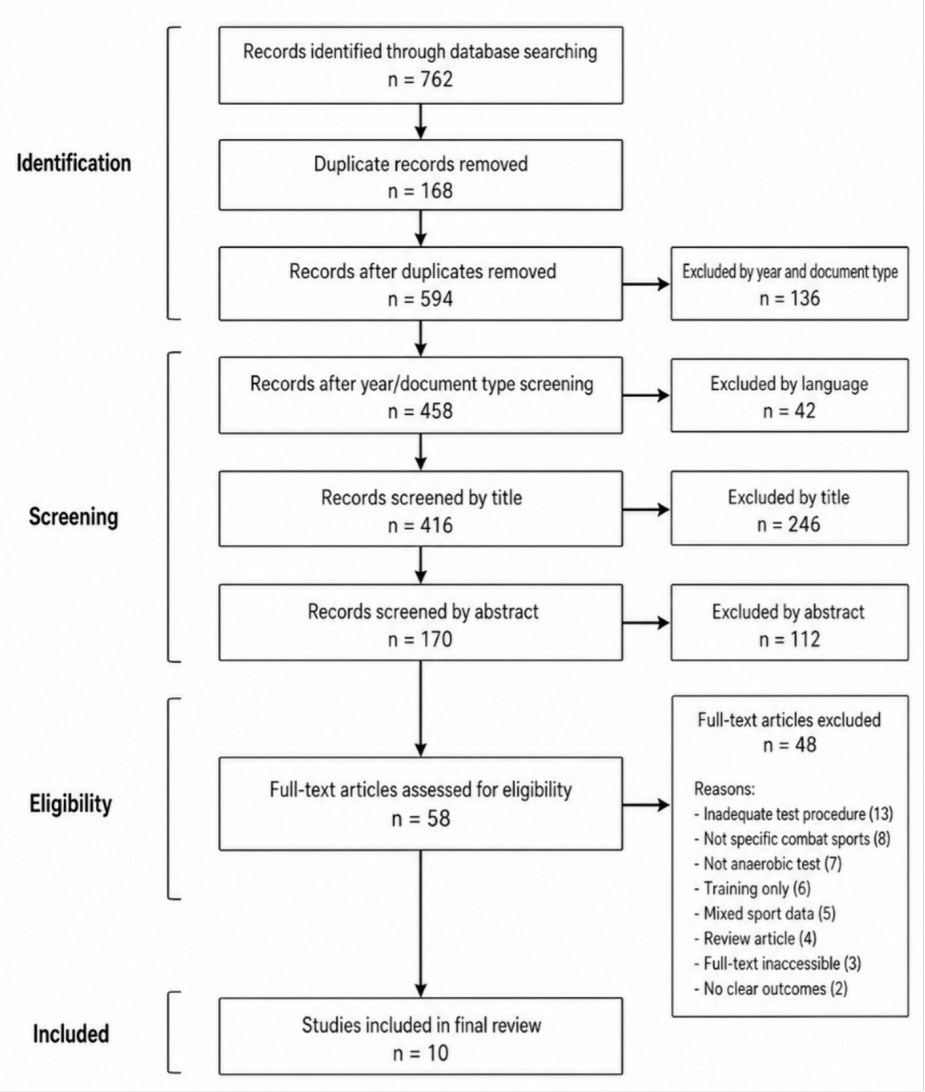

Figure 1. Research design using PRISMA

pencak silat. The results of the anaerobic endurance measurements are presented in Table 1.

The analysis results presented in Table 1 indicate that anaerobic endurance measurement models in martial arts can be grouped into discipline-specific tests, laboratory tests, general field tests, and fatigue index-based tests. Discipline-specific tests are found in taekwondo through the Taekwondo Intermittent Anaerobic Kick Test and the Taekwondo-Specific Aerobic-Anaerobic-Agility Test, in kickboxing through the Kickboxing Anaerobic Speed Test, in mixed martial arts through the Specific Anaerobic Assessment for MMA, and in Brazilian jiu-jitsu through the Jiu-Jitsu-Specific Performance Test. These models have characteristics that are closer to competition movement patterns because they use actions such as kicks, punches, total attacks, or repetitions of techniques. Several studies also tested the validity and reliability of these instruments directly. Thus, these studies provide methodological support that discipline-specific tests can be used to assess the anaerobic performance of martial arts practitioners more relevantly than general tests.

In addition to sport-specific tests, several articles also used common laboratory and field tests, such as the Wingate Anaerobic Test, the 30-second Sustained Jump Test, the Running-Based Anaerobic Sprint Test, and fatigue index-based measurements. The Wingate test is used to describe upper and lower extremity anaerobic capacity, whereas the 30-second Sustained Jump Test is considered a practical alternative for assessing anaerobic strength and anaerobic capacity in child karate athletes. In the context of pencak silat, the identified test models mostly use RAST and fatigue index measurements to describe athletes' anaerobic ability. In general, the review results indicate that the selection of anaerobic endurance tests in martial arts needs to consider sport specificity, measurement objectives, sample characteristics, practicality of implementation, and evidence of the validity and reliability of each instrument.

Table 1. Studies included in the final review

Title (Author)	Type of Combat Sport	Design or Study Type	Sample	Test / Instrument	Output Measurement	Main Findings
Taekwondo Anaerobic Intermittent Kick Test: Discriminant Validity and an Update with the Gold-Standard Wingate Test [11]	Taekwondo	A study of discriminant validity and concurrent validity	Elite and sub-elite taekwondo athletes	Taekwondo Anaerobic Intermittent Kick Test, 30-s Wingate Anaerobic Test, squat jump, countermovement jump	Intermittent kick performance, anaerobic power, jumping performance	The TAIKT can be used as a taekwondo-specific test to assess kick-based anaerobic performance
A New Taekwondo-Specific Field Test for Estimating Aerobic Power, Anaerobic Fitness, and Agility Performance [16]	Taekwondo	Development and validation of a taekwondo-specific field test	Male athletes aged 18–35 years with black belt and red belt levels	Taekwondo-specific Aerobic-Anaerobic-Agility Test (TAAA)	Aerobic power, anaerobic fitness, agility performance	TAAA can be a taekwondo-specific multidimensional test to measure physical abilities relevant to competition needs
Reliability and Validity of the Kickboxing Anaerobic Speed Test [13]	Kickboxing	A study of test-retest reliability and discriminative validity	42 male kickboxing athletes, consisting of 18 elite athletes and 24 sub-elite athletes	Kickboxing Anaerobic Speed Test (KAST); maximal cycling sprint test	Kickboxing-specific anaerobic performance speed	KAST supports kickboxing-specific anaerobic performance measurement and can differentiate athlete levels
Validity and Reliability of a Specific Anaerobic Test for Mixed Martial Arts [12]	Mixed Martial Arts	Validity and reliability study	12 male MMA athletes	Specific Anaerobic Assessment for MMA (ASA-MMA); graded incremental test; MAOD	Total strike rate, anaerobic capacity, aerobic power, test reproducibility	The ASA-MMA can be used to assess the anaerobic profile of MMA athletes more specifically than general tests
Validity and Reliability of the 30-s Continuous Jump Test for Anaerobic Power and Capacity Assessment in Combat Sports [17]	Karate / combat sport	Validity and reliability study	13 female karate athletes	30-s Continuous Jump Test (CJ30s); Wingate Anaerobic Test	Anaerobic strength, anaerobic capacity, repeated jump performance	The CJ30s has proven to be reliable and can be used as a practical test to assess strength and anaerobic capacity in child karate athletes

Table 1. Continued

Title (Author)	Type of Combat Sport	Design or Study Type	Sample	Test / Instrument	Output Measurement	Main Findings
Jiu-Jitsu-Specific Performance Test: Reliability Analysis and Construct Validity in Competitive Athletes [18]	Brazilian Jiu-Jitsu	Reliability, sensitivity, and construct validity studies	60 Brazilian jiu-jitsu athletes	Jiu-Jitsu-Specific Performance Test (JJAPT)	Repetition of techniques, jiu-jitsu-specific anaerobic performance, differences in athlete levels	JJAPT demonstrates good performance reliability and can differentiate the ability levels of BJJ athletes
Anaerobic Performance Profiling in Elite Amateur Boxers [5]	Boxing	Anaerobic performance profile study	12 elite male amateur boxers	Wingate cycling, arm cranking, boxing bag punching, steep uphill running, VO_2max test	Peak power, mean power, test duration, punching frequency, blood lactate, heart rate	A combination of general and punch-specific tests can provide a more comprehensive picture of a boxer's anaerobic performance profile
Anaerobic Capacity of Upper and Lower Limb Muscles in Combat Sports Contestants [19]	Combat sports, especially wrestling and boxing	Anaerobic capacity measurement study	Combat sport athletes	Wingate test for upper and lower extremities	Anaerobic capacity of arm and leg muscles	Wrestling and boxing athletes need to have good anaerobic capacity in the upper and lower extremities
Anaerobic Ability and Fatigue Index Analysis of Pencak Silat Athletes at the West Sumatra Sports Talent Association [KBOR] [20]	Pencak silat	Quantitative descriptive study	Pencak silat athletes from the Sports Talent category in West Sumatra Province	Running-based Anaerobic Sprint Test (RAST)	Anaerobic capacity and fatigue index	RAST is used to describe the anaerobic capacity and fatigue index of pencak silat athletes
Measurement of Anaerobic Capacity Based on Fatigue Index for Pencak Silat Athletes in the Combat Category [21]	Pencak silat in the combat category	Quantitative descriptive study	15 pencak silat athletes from the undergraduate sports education program	Measurement of anaerobic capacity based on fatigue index	Fatigue index, anaerobic capacity	This research is relevant to the context of pencak silat because it directly measures the anaerobic capacity of combat category athletes based on the fatigue index

Discussion

The findings of this study indicate that anaerobic endurance measurement models in martial arts are highly diverse and influenced by the characteristics of the sport. This diversity is evident in the use of kick-based tests in taekwondo, anaerobic speed tests in kickboxing, total punch-based tests in mixed martial arts, technique repetition-based tests in Brazilian Jiu-Jitsu, and fatigue index-based tests in pencak silat. These findings reinforce the view that performance in martial arts cannot be assessed solely through a single general testing model. Each sport has different movement patterns, action durations, rest intervals, limb usage, and physiological demands. Previous literature has explained that endurance assessment in martial arts is complex because it is influenced by mechanical efficiency, maximal aerobic capacity, metabolic threshold, and anaerobic capacity [22, 23]. Therefore, the selection of tests needs to be adjusted to the measurement objectives and characteristics of the sport.

The findings of this review also suggest that sport-specific tests are valuable because they better align with competitive movement patterns than general tests. In taekwondo, the Taekwondo Anaerobic Intermittent Kick Test (TAIKT) is used to assess kick-based anaerobic performance and is compared with the Wingate Anaerobic Test as a comparator. Previous studies have shown that the TAIKT has concurrent validity and can differentiate between competitive levels of taekwondo athletes [11]. In addition, studies have reported the development of the Taekwondo-specific Aerobic-Anaerobic-Agility Test (TAAA) as a multidimensional test to estimate aerobic strength, anaerobic fitness, and agility in taekwondo athletes [16]. In kickboxing, the KAST was shown to have test-retest reliability and discriminative validity, whereas in MMA, the ASA-MMA was found to be reliable and correlated with anaerobic capacity and aerobic power [12, 13]. In Brazilian Jiu-Jitsu, the JJAPT also demonstrated performance reliability and construct validity because it was able to differentiate between novice and advanced athletes [18]. This evidence suggests that TAIKT, TAAA, KAST, ASA-MMA, and JJAPT are more relevant to certain disciplines because they use activities that are closer to the technical demands of those sports.

Although sport-specific tests have advantages in terms of ecological validity, laboratory tests and general tests still have an important role in measuring the anaerobic abilities of martial arts athletes. The Wingate Anaerobic Test is still widely used because it can provide physiological indicators such as peak power, mean power, and fatigue index, and it can be applied to both the upper and lower extremities. Other studies have shown that wrestling and boxing athletes require high anaerobic capacity in the arm and leg muscles [24, 25]. Therefore, measurements of the upper and lower limbs can help describe the anaerobic profile of different body parts. In addition to the Wingate test, the 30-second Continuous Jump Test (CJ30s) has also been shown to have validity and reliability for assessing anaerobic strength and anaerobic capacity in child karate athletes [17]. Thus, it can be used as a more practical alternative to field tests.

The different characteristics of striking, grappling, and mixed combat also contribute to the lack of a fully standardized anaerobic testing model. Striking sports such as taekwondo, kickboxing, and boxing place greater emphasis on the ability to deliver rapid and repeated punches or kicks. Therefore, tests based on kicks, punches, punch frequency, or a combination of techniques are more appropriate for describing specific performance. Studies involving elite boxers have shown that the use of multiple maximal tests, such as the Wingate cycle, arm ergometer, punching bag, and uphill running, can provide a more comprehensive picture of metabolic and cardiovascular responses in boxing [5]. In contrast, grappling disciplines such as Brazilian Jiu-Jitsu and wrestling require the ability to maintain technique repetition, body control, pushes, pulls, and positional transitions. Therefore, technique repetition-based tests such as the Jiu-Jitsu Anaerobic Performance Test (JJAPT) are more relevant [18]. Meanwhile, MMA has mixed characteristics involving both striking and grappling [12]. Therefore, the ASA-MMA, which uses MMA-specific movements, is better able to describe an athlete's anaerobic profile than a single test that assesses only one movement pattern.

From a methodological perspective, the findings of this review indicate that validity, reliability, and standardization of procedures remain critical issues in measuring anaerobic endurance in martial arts. Some tests, such as the TAIKT, KAST, ASA-MMA, CJ30s, and JJAPT, have established validity and reliability, making them more suitable for practical use. However, several other tests, particularly in the context of pencak silat, are still primarily used as anaerobic capacity profiling tools. These tests have not been specifically evaluated for validity and reliability as sport-specific tests. Furthermore, monitoring physical and sport-specific performance is important in elite sports, but the tests used need to be analyzed based on their methodological quality, validation data, and suitability for use [26, 27]. Therefore, coaches and researchers need to be careful when selecting instruments because practical tests do not necessarily have high validity, and physiologically valid tests are not necessarily specific to particular sport movement patterns.

Research Implications

The implications of this study are that coaches, lecturers, researchers, and sports science

practitioners need to select anaerobic endurance test models based on the characteristics of the sport, measurement objectives, available facilities, and evidence of validity and reliability. For sports involving striking, kick- or punch-based tests may be prioritized because they better reflect match activity. For wrestling and mixed combat, tests involving technique repetition, total number of strikes, or match-specific actions are more relevant than general tests. In the context of pencak silat, the results of this review provide a basis for anaerobic measurement, which is still dominated by RAST and fatigue index measurements. Therefore, it is necessary to develop tests that are more specific to the characteristics of pencak silat. For example, such tests may incorporate patterns of attacks, evasions, blocks, falls, and repeated high-intensity activity.

Research Limitations

This study has several limitations. First, the number of analyzed articles was limited to 10 primary articles, so the review results cannot fully describe the variation in anaerobic testing models across all martial arts. Second, the analyzed articles varied in study design, sample characteristics, athlete level, test type, and outcome indicators. Therefore, this study used narrative synthesis and did not conduct a meta-analysis. Third, articles in the context of pencak silat are still limited, and most have not focused on testing the validity and reliability of sport-specific tests. Fourth, some articles used general tests or laboratory tests that are physiologically robust but do not fully reflect actual competition movement patterns. Therefore, further research is recommended to develop and test more specific anaerobic endurance testing models for various martial arts, particularly pencak silat, by considering validity, reliability, sensitivity, practicality, and suitability to competition characteristics.

Conclusions

This study shows that anaerobic endurance measurement models in martial arts vary widely and are influenced by the characteristics of each sport. Sport-specific tests such as the TAIKT, TAAA, KAST, ASA-MMA, and JJAPT are relevant because their procedures are more closely aligned with competitive movement patterns, such as kicks, punches, total strikes, and technique repetitions. Meanwhile, general tests such as the Wingate Anaerobic Test, the 30-second Continuous Jump Test, the RAST, and fatigue index measurements remain useful for assessing anaerobic capacity, especially when sport-specific tests are not yet available. Furthermore, the selection of anaerobic tests in martial arts requires consideration of sport specificity, measurement objectives, athlete characteristics, practicality, and evidence of validity and reliability. In the context of pencak silat, the development of more specific, valid, and reliable anaerobic tests tailored to competition characteristics is still needed. These findings can provide a basis for coaches, researchers, and sports science practitioners in selecting and developing anaerobic endurance test models in combat sports.

Conflict of Interest

The researcher has no conflicts of interest.

References

1. Almas KZ, Lismadiana L, Tomoliyus T, Hariono A, Danardono D, Prabowo TA, et al. Contribution of coordination, balance, flexibility, arm muscle strength to the 'kizami-gyaku zuki' punch: analysis of female karate athletes. *European Journal of Physical Education and Sport Science*, 2023;10(4). https://doi.org/10.46827/ejpe.v10i4.5097
2. Kons RL, Conceição-Santos DF, Carmo EFSD, Athayde MSDS, Agostinho MF, Lopes-Silva JP, et al. Are World Championship participation and seed status predictors of Olympic success in judo? *Managing Sport and Leisure*, 2025; 1–6. https://doi.org/10.1080/23750472.2025.2519117
3. James LP, Haff GG, Kelly VG, Beckman EM. Towards a Determination of the Physiological Characteristics Distinguishing Successful Mixed Martial Arts Athletes: A Systematic Review of Combat Sport Literature. *Sports Medicine*, 2016;46(10): 1525–1551. https://doi.org/10.1007/s40279-016-0493-1
4. Tortu E, Ouergui I, Ulupinar S, Özbay S, Gençoğlu C, Ardigò LP. The contribution of energy systems during 30-second lower body Wingate anaerobic test in combat sports athletes: Intermittent versus single forms and gender comparison. Kuvačić G (ed.) *PLOS ONE*, 2024;19(5): e0303888. https://doi.org/10.1371/journal.pone.0303888
5. VenckunasT,BruzasV,SnieckusA,StasiuleL,Kniubaite A, Mickevicius M, et al. Anaerobic Performance Profiling in Elite Amateur Boxers. *Sports*, 2024;12(9): 231. https://doi.org/10.3390/sports12090231
6. Franchini E. Energy System Contributions during Olympic Combat Sports: A Narrative Review. *Metabolites*, 2023;13(2): 297. https://doi.org/10.3390/metabo13020297
7. Prabowo TA, Wangi SP. The Effect of Punching Bag Drills with Intervals on Anaerobic Endurance in Boxers. *Journal Sport Science Indonesia*, 2025;4(1): 39–48. https://doi.org/10.31258/jassi.4.1.39-48
8. Wedi S, Tomoliyus T, Fauzi F, Gemaini A, Prabowo TA. Innovation, Validity, and Reliability of Modified Dynamic Balance Test for Karate Kata Category. *Sport Mont*, 2024;22(3):25-30. https://doi.org/10.26773/smj.241004
9. Castro RR, Fernandes AM. The win fight test: proposal of a punching fatigue and anaerobic test for combat sports athletes. *Medicine &*

Science in Sports & Exercise, 2020;52(7S): 40–41. https://doi.org/10.1249/01.mss.0000670424.44362.45
10. Gusciglio B, Morin JB. Assessing The Key Physical Capabilities in Striking Combat Sports: Reliability And Reproducibility of A New Test. *International Journal of Strength and Conditioning*, 2023;3(1). https://doi.org/10.47206/ijsc.v3i1.207
11. Tayech A, Mejri MA, Chaouachi M, Chaabene H, Hambli M, Brughelli M, et al. Taekwondo Anaerobic Intermittent Kick Test: Discriminant Validity and an Update with the Gold-Standard Wingate Test. *Journal of Human Kinetics*, 2020;71(1): 229–242. https://doi.org/10.2478/hukin-2019-0081
12. Andrade VL, Foresti YF, Almeida PB, Araujo MYC, Kalva-Filho CA, Papoti M. Validity and reliability of a specific anaerobic test for mixed martial arts. *Science & Sports*, 2022;37(5–6): 488.e1-488.e10. https://doi.org/10.1016/j.scispo.2021.10.006
13. Gençoğlu C, Ulupınar S, Özbay S, Ouergui I, Franchini E. Reliability and Validity of the Kickboxing Anaerobic Speed Test. *Research Quarterly for Exercise and Sport*, 2023;94(3): 715–724. https://doi.org/10.1080/02701367.2022.2048783
14. Hanflink J, Peacock CA, Sanders GJ, Antonio J. Performance Metrics of Anaerobic Power in Professional Mixed Martial Arts (MMA) Fighters. *Journal of Functional Morphology and Kinesiology*, 2025;10(3): 358. https://doi.org/10.3390/jfmk10030358
15. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, 2021; n71. https://doi.org/10.1136/bmj.n71
16. Taati B, Arazi H, Bridge CA, Franchini E. A new taekwondo-specific field test for estimating aerobic power, anaerobic fitness, and agility performance. Boullosa D (ed.) *PLOS ONE*, 2022;17(3): e0264910. https://doi.org/10.1371/journal.pone.0264910
17. Čular D, Ivančev V, Zagatto AM, Milić M, Beslija T, Sellami M, et al. Validity and Reliability of the 30-s Continuous Jump for Anaerobic Power and Capacity Assessment in Combat Sport. *Frontiers in Physiology*, 2018;9: 543. https://doi.org/10.3389/fphys.2018.00543
18. Da Silva Junior JN, Kons RL, De Lucas RD, Detanico D. Jiu-Jitsu-Specific Performance Test: Reliability Analysis and Construct Validity in Competitive Athletes. *Journal of Strength & Conditioning Research*, 2022;36(1): 174–179. https://doi.org/10.1519/JSC.0000000000003429
19. Hübner-Woźniak E, Kosmol A, Błachnio D. Anaerobic capacity of upper and lower limbs muscles in combat sports contestants. *Journal of Combat Sports and Martial Arts*, 2011;2(2): 91–94. https://doi.org/10.5604/20815735.1047140
20. Lestari PS, Suwirman S. Analisis Kemampuan Anaerobic dan Fatigue Index Atlet Pencak Silat Kebakatan Olahraga (KBOR) Sumatera Barat. *Jurnal JPDO*, 2024;7(6). https://doi.org/10.24036/JPDO.7.6.2024.135
21. Subekti N, Ahmad Syaukani A, Fatoni M. Measurement of Anaerobic Capacity Based On Fatigue Index for Pencak Silat Athletes on Combat Category. *International Summit on Science Technology and Humanity*, 2019;681–686.
22. Barley OR, Chapman DW, Guppy SN, Abbiss CR. Considerations When Assessing Endurance in Combat Sport Athletes. *Frontiers in Physiology*, 2019;10: 205. https://doi.org/10.3389/fphys.2019.00205
23. Plush MG, Guppy SN, Nosaka K, Barley OR. Developing a Comprehensive Testing Battery for Mixed Martial Arts. *International Journal of Exercise Science*, 2021;14(4):941–961. https://doi.org/10.70252/BUHI5001
24. Ruddock A, James L, French D, Rogerson D, Driller M, Hembrough D. High-Intensity Conditioning for Combat Athletes: Practical Recommendations. *Applied Sciences*, 2021;11(22): 10658. https://doi.org/10.3390/app112210658
25. Mavliev FA, Zotova FR, Nazarenko AS, Ivanova ES, Gerasimova IG. Enhancing anaerobic performance of wrestlers by means of special exercises. *Human Sport Medicine*, 2021;21:79–87. https://doi.org/10.14529/hsm21s211
26. Chaabene H, Negra Y, Bouguezzi R, Capranica L, Franchini E, Prieske O, et al. Tests for the Assessment of Sport-Specific Performance in Olympic Combat Sports: A Systematic Review With Practical Recommendations. *Frontiers in Physiology*, 2018;9: 386. https://doi.org/10.3389/fphys.2018.00386
27. S W, Gemaini A, Fauzi F, Prabowo TA. Dynamic balance test modifications in Karate Kata: Content validity. *SPORT TK-Revista EuroAmericana de Ciencias del Deporte*, 2025;14: 113. https://doi.org/10.6018/sportk.581941

Information about the authors:

Trisnar Adi Prabowo; (Corresponding Author); https://orcid.org/0000-0001-6977-0503; trisnar.prabowo@umbs.ac.id; Physical Education Study, Universitas Muhammadiyah Brebes; Jawa Tengah, Indonesia.

Asyidika Vito Indarto; https://orcid.org/0009-0005-3210-8379; asyidika.vito@umbs.ac.id; Physical Education Study, Universitas Muhammadiyah Brebes; Jawa Tengah, Indonesia.

Ma'ratul Afifah; https://orcid.org/0009-0004-2849-6543; maratul.afifah@umbs.ac.id; Physical Education Study, Universitas Muhammadiyah Brebes; Jawa Tengah, Indonesia.

Febriansyah Dwi Cahyo; https://orcid.org/0009-0006-6845-9602; riancahyoqwerty@gmail.com; Physical Education Study, Universitas Muhammadiyah Brebes; Jawa Tengah, Indonesia.

Zakwan Yumna Dhuha Pahlavi; https://orcid.org/0009-0008-2127-754X; zakwanyumna1@gmail.com; Physical Education Study, Universitas Muhammadiyah Brebes; Jawa Tengah, Indonesia.

Achmad Zakaria; https://orcid.org/0009-0006-6184-1112; achmadzakaria@umbs.ac.id; Physical Education Study, Universitas Muhammadiyah Brebes; Jawa Tengah, Indonesia.

Cite this article as:
Prabowo TA, Indarto AV, Afifah M, Cahyo FD, Pahlavi ZYD, Zakaria A. Models of anaerobic endurance measurement tests in combat sport: literature review. *Physical Culture, Recreation and Rehabilitation*, 2026;5(2):90–99.
https://doi.org/10.15561/physcult.2026.0204

Received: 2026-04-20
Accepted: 2026-05-22
Published: 2026-05-24