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TIME CHARACTERISTICS OF KARATE PRACTITIONERS' TECHNICAL MOVEMENTS DURING THE PRELIMINARY BASIC TRAINING PHASE

Ivan Mudrik

Lviv State University of Physical Culture named after Ivan Boberskyj, Ukraine

ivan27mudryk@gmail.com; <https://orcid.org/0009-0005-5697-8045>

Abstract

One of the main criteria for evaluating a karate athlete's technique in competitive conditions is the focused execution of individual phases of competitive exercises, the duration of which depends on the complexity of the overall time structure of the competitive exercise. *Goal of research:* to investigate the temporal characteristics of the «Sweep-forward-strike» and «Attack from a clinch» competitive exercises performed by karate-do athletes. *Research methods used:* In this study, we employed the following research methods: theoretical analysis of literature sources, pedagogical observation using instrumental methods of video-biomechanical analysis and multifunctional accelerometry, and statistical methods. The study involved 30 male karate athletes training at the preliminary basic training stage. *The results:* The results of the pedagogical observation of the rhythm of competitive exercises performed by karate athletes at the preliminary basic training stage are presented. An analysis of the temporal structure of the «Sweep-forward-strike» competitive exercise revealed that athletes perform a pronounced sweep with the attacking foot at a minimal distance from the tatami, which facilitates throwing the opponent off balance. It was established that the exercise

structure consists of three phases performed with a sequential decrease in their duration. However, this duration of key points does not correspond to the correct rhythm of this competitive exercise, indicating that athletes focus their efforts on preparatory actions. A study of the temporal structure of the competitive exercise «Attack from a clinch» revealed that athletes spend the most time on phases such as transitioning into a clinch, exiting the clinch, and completing the strike – exiting the attack zone. *Conclusions.* The data on the analysis of rhythmic patterns in competitive exercises performed by athletes training at the basic preparation stage have been expanded, with an emphasis on the rational distribution of effort during the execution of competitive exercises. Time characteristics have been identified that fully characterize the technique of performing the competitive exercises «Sweep-forward-strike» and «Attack from a clinch» and can be used to monitor the development of technical proficiency in young athletes.

Keywords: karate-do; rhythm; competitive exercise; temporal structure.

Мудрик І. Часові характеристики технічних дій каратистів на етапі попередньої базової підготовки.

Анотація. Одним з основних критеріїв оцінки техніки спортсмена-каратиста в умовах змагальної боротьби є акцентоване виконання окремих фаз змагальних вправ, тривалість яких залежить від складності часової структури змагальної вправи в цілому. *Мета дослідження:* дослідити часові характеристики змагальних вправ «Підсічка через удар» та «Атака з клінчу» спортсменів у карате-до. *Методи дослідження:* У роботі нами застосовані такі методи наукового дослідження: теоретичний аналіз літературних джерел, педагогічне спостереження з використанням інструментальних методик комплексу відео-біомеханічного аналізу та багатофункціональної акселерометрії, методи математичної статистики. У дослідженні приймали участь 30 спортсменів-каратистів (чоловіки), котрі тренуються на етапі попередньої базової підготовки. *Результати.* Подано результати проведеного педагогічного спостереження за ритмом змагальних вправ спортсменів-каратистів на етапі попередньої базової підготовки. Дослідження часової структури змагальних вправ «Підсічка через удар» установлено, спортсмени виконують акцентовано підсічку на мінімальній відстані стопи атакуючої ноги від татамі, що полегшує виведення суперника зі стану рівноваги. Установлено, що у структурі вправи є три фази котрі виконуються з послідовним зменшенням їх тривалості. Проте, така тривалість вузлових пунктів не відповідає правильному ритму цієї змагальної вправи, і свідчить про те, що спортсмени акцентують зусилля на

підготовчих діях. Дослідженням часової структури змагальної вправи «Атака з клінчу» встановлено, що спортсмени витрачають найбільше часу на такі фази як перехід в клінч – вихід з клінчу та закінчення удару – вихід з зони атаки. *Висновки.* Розширено дані щодо аналізу ритмових моделей змагальних вправ спортсменів, які тренуються на етапі базової підготовки з акцентом у на раціонального розподілу зусиль підчас виконання змагальних вправ. Визначено, часові характеристики, котрі повною мірою характеризують техніку виконання змагальних вправ «Підсічка через удар» та «Атака з клінчу», та можуть використовуватись для контролю за становленням технічної майстерності юних спортсменів.

Ключові слова: карате-до; ритм; змагальна вправа; часова структура.

Introduction

Problem statement. Competitive activity in karate-do requires athletes to possess a high level of mastery of specialized movements, which are performed with high precision under conditions of limited time and space, against a backdrop of nervous and emotional tension and opposition from the opponent [12]. In turn, the execution of strikes, throws, and sweeps is impossible without a focused distribution of effort in space and time [5].

One of the main criteria for evaluating a karate athlete's technique in competitive combat is the focused execution of individual phases of competitive exercises, the duration of which depends on the complexity of the temporal structure of the competitive exercise as a whole [15, 35]. During the preliminary basic training phase and subsequent stages of long-term training, the athlete must master the technique of dozens of specialized training exercises quite well, which is practically impossible to do without a proper understanding of the temporal structure of competitive exercises [17].

Analysis of recent research and publications. The scientific and methodological literature on the subject of this study primarily describes elements of physical training in karate-do and certain aspects of the methodology for its study [1, 8, 14, 18, 24]. The role and significance of technical training as a factor in the development of karate-do and the high achievements of athletes in competitive activity have been proven [6, 13, 25].

It has been determined [12, 26] that during the preliminary basic training phase and subsequent phases of long-term training, a young athlete must master the technique of dozens of specialized training exercises quite well. As noted [23, 27], this cannot be achieved without a proper understanding of the temporal structure of competitive exercises. However, the issue of scientifically grounded methods for the technical training of karateka in terms of the

temporal structure of competitive exercises has not received adequate attention in the literature.

It has been established [1] that the greater the number of techniques and actions an athlete possesses, the better prepared they are to solve complex tactical problems that arise during competitive combat. Accordingly, they can more effectively counter their opponent's attacking actions while simultaneously provoking them into making inadequate situational decisions [2]. Research [7] has shown that the arsenal of offensive and defensive actions in this sport is extremely broad, including strikes with hands and feet, throws, and sweeps [4, 10].

Researchers [16] classify the following as defensive actions: blocks, parries, and evades. The ability to combine strikes, sweeps, throws, and maneuvers into a rational sequence of movements is recognized as the most important aspect of a karate athlete's technical preparedness [19].

Materials and methods

Research objective: to develop time models for the «Sweep-forward-strike» and «Attack from a clinch» competitive techniques performed by karate-do athletes.

In this study, we employed the following research methods:

1. Theoretical analysis of the literature.
2. To determine the duration of competitive exercises, as well as their individual phases, we conducted pedagogical observation using instrumental methods (a complex of video-biomechanical analysis and multifunctional accelerometry). This hardware-instrumental complex was developed by specialists from the Department of Gymnastics, Sports Dance, Fitness, and the Research Institute of Physical Culture and Non-Olympic Sports at the Kharkiv State Academy of Physical Culture. This complex has no analogues and is distinguished by its mobility and accessibility for solving a wide range of problems related to the study, analysis, and correction of athletes' motor activity in sports requiring complex coordination, particularly in karate-do. The complex consists of a multifunctional accelerometry system and a video-biomechanical motion analysis system [20].

3. Methods of mathematical statistics [34].

Study design. The study involved 30 qualified male karate athletes who were training at the preliminary basic training stage. The study examined the competitive techniques «Sweep-forward-strike» and «Attack from a clinch», which are learned by athletes in the early stages of training and applied during competitions. The time taken to perform the

competition exercise (*ms*) as a whole and the duration of its individual parts (key points) were measured.

Results

Technical readiness in karate-do is the degree to which an athlete has mastered the system of movements [28]. Technical preparedness cannot be considered in isolation but should be viewed as a component of a unified whole in which technical decisions are closely interrelated with the athlete's physical, mental, and tactical capabilities, as well as with the specific conditions of the external environment in which the sporting action is performed, depending on the situation characteristic of a particular moment of competitive activity [29].

Individual variations in rhythm also depend on the athlete's individual characteristics. Different karate athletes may exhibit their own distinctive features of rhythm. However, these features must not exceed certain limits defined by the objectively necessary rhythmic structure of competitive exercises [30]. By understanding this structure, every karateka can consciously shape and regulate the rhythms of competitive exercises.

Research [11] has shown that knowledge of the rhythmic patterns of sports technique in karate-do allows for the refinement of control over technically diverse actions and the very process of learning the technique. Therefore, the more accurately karateka reproduce the direction, speed, and frequency of movements, the more correctly they will be able to place emphasis and apply force at the right moment during technical actions. This will subsequently have a positive impact on the development of technical mastery.

An analysis of the data obtained from the study (Fig. 1) revealed that as karateka's athletic proficiency increases, the structure of the «Sweep-forward-strike» competition exercise undergoes certain changes related to the duration of its individual phases. It was determined that the performance metrics of karate athletes indicate the presence of several consecutive accelerations in the time structure, ranging in duration from 240 *ms* to 180 *ms*.

The principle of executing the «Sweep-forward-strike» technique is that the athlete delivers a hand strike to the opponent's head without making contact at eye level in order to mislead the opponent about their true intentions and reduce the opponent's visual awareness of the technique. After the hand strike, a «De Ashi Barai (Advancing Foot Sweep)» is performed under the opponent's front leg, throwing them off balance, followed by a strike to the torso or head.

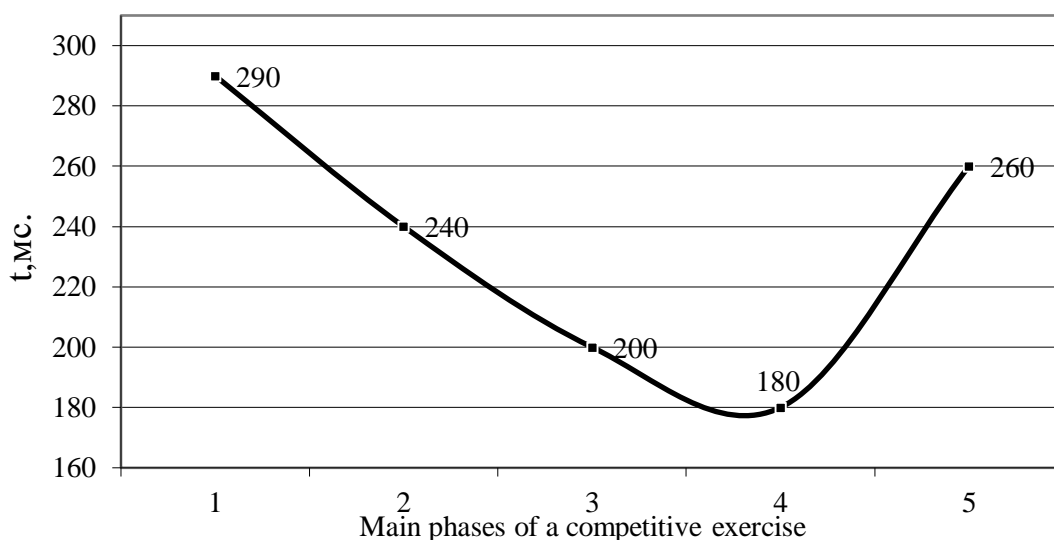


Fig. 1. Temporal structure of the «Sweep-forward-strike» technical action performed by athletes during the preliminary basic training phase: 1 – entry into the attack zone – start of the strike; 2 – start of the strike – end of the strike; 3 – end of the strike – start of the sweep; 4 – start of the sweep – end of the sweep; 5 – end of the sweep – exit from the attack zone

The timing metrics for the execution of the competitive exercise «Sweep Through Attack»(Fig. 2) indicate that the exercise structure comprises three phases performed with a sequential decrease in their duration: the 2nd, 3rd, and 4th phases, respectively. Athletes execute strikes lasting 240 *ms*, while preparatory actions – that is, the «end of strike – beginning of sweep» phase – last 200 *ms*. Such durations of key points do not correspond to the correct rhythm of this competitive exercise and indicate that athletes are focusing their efforts on preparatory actions. However, they should focus their efforts on the main phases, such as «start of the strike – end of the strike» and «start of the sweep – end of the sweep».

Since phases 2–4 are performed with a gradual increase in movement power, the shortest is phase 4 – start of the sweep – end of the sweep which lasts 140 *ms*. Equally important is the second phase, start of the kick – end of the kick – 190 *ms*, which essentially determines the ability to effectively execute the kick and the competitive exercise as a whole.

Analysis of accelerometric data revealed the presence of a clearly pronounced emphasis of effort in the rhythmic structure of the competitive exercise «Sweep through an attack» during the forward-backward movement of the right leg, with a duration of 16 *m/s²*, accompanied by a slight amplitude of movement of 0.2 *m/s²*. Thus, athletes perform an accentuated sweep with the attacking foot at a minimal distance from the mat, which facilitates throwing the opponent off balance.

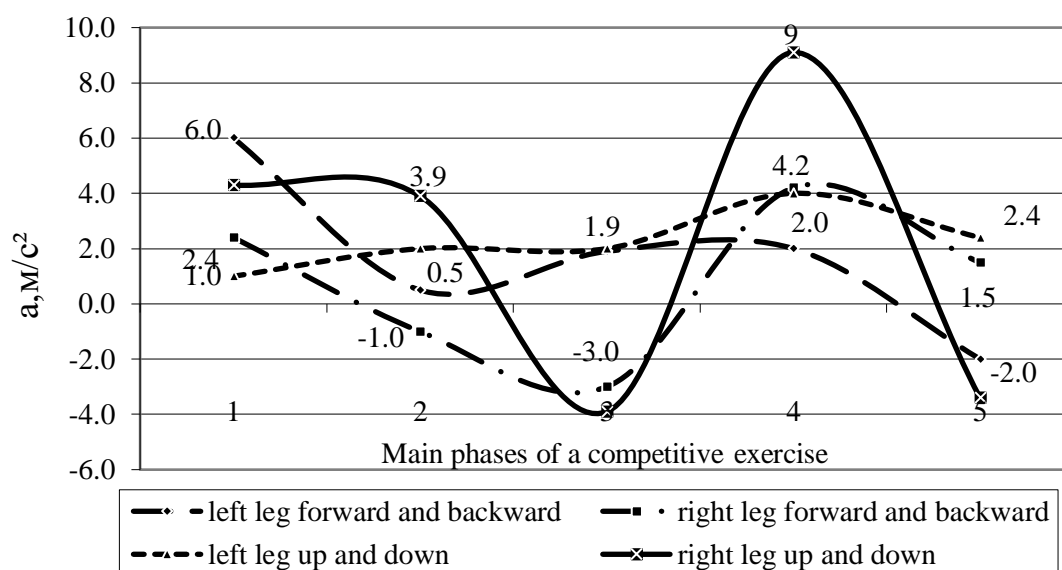


Fig. 2. Accelerometer readings for athletes' legs during the «Sweep-forward-strike» competition exercise: 1 – entry into the attack zone – start of the strike; 2 – start of the strike – end of the strike; 3 – end of the strike – start of the sweep; 4 – start of the sweep – end of the sweep; 5 – end of the sweep – exit from the attack zone

The competitive exercise «Attack from a clinch» belongs to a series of complex attacks targeting the front arm, performed in several movements, and is multi-phase in nature. The essence of this exercise lies in the athlete's purposeful entry into a clinch with the opponent, grabbing the right or left arm depending on the athlete's stance, and executing a leg attack (to the torso) under the held arm. By holding the opponent's arm, the attacking athlete faces no obstacles (from disruptive movements) while executing the attack. This is the key to successfully performing the competitive exercise «Attack from a clinch» and its evaluation by the judge.

As a result of studying the temporal structure of the competitive exercise «Attack from a clinch» (Fig. 3), it was established that athletes spend the most time on phases such as transitioning into the clinch – exiting the clinch – 240 *ms*, and completing the strike – exiting the attack zone – 220 *ms*.

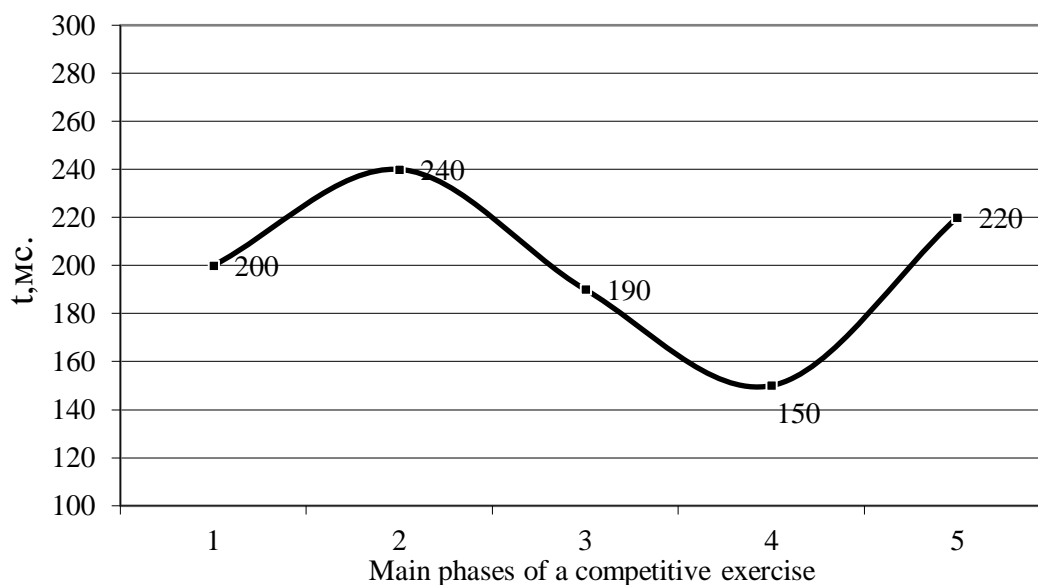


Fig. 3. Time structure of the technical action «Attack from a clinch» performed by karate athletes: 1 – entry into the attack zone – transition to a clinch; 2 – transition to a clinch – exit from the clinch; 3 – exit from the clinch – start of the strike; 4 – start of the strike – end of the strike; 5 – end of the strike – exit from the attack zone

The duration of the third phase of this competitive exercise is 190 *ms*, indicating a rapid exit from the clinch and a grip on the opponent's arm. This technique is a prerequisite for a subsequent leg attack, which lasts 150 *ms*.

It should be noted that the duration of the striking phase in the «Attack from a clinch» competition exercise is the shortest among all other parts of this technical action. However, the emphasis of effort is placed not only on the striking part but also on the preparatory part, i.e., the exit from the clinch – the beginning of the strike – as evidenced by the results of the accelerometric study (Fig. 4).

An analysis of the accelerometric data for the «Attack from a clinch» competition exercise revealed that the greatest concentration of effort occurs during the forward-backward movement of the right leg – 16.8 m/s^2 in the fourth phase of this technical action. This is due to the fact that the leg strike is performed precisely in the fourth phase, and consequently, the forces applied to execute the attack are maximal.

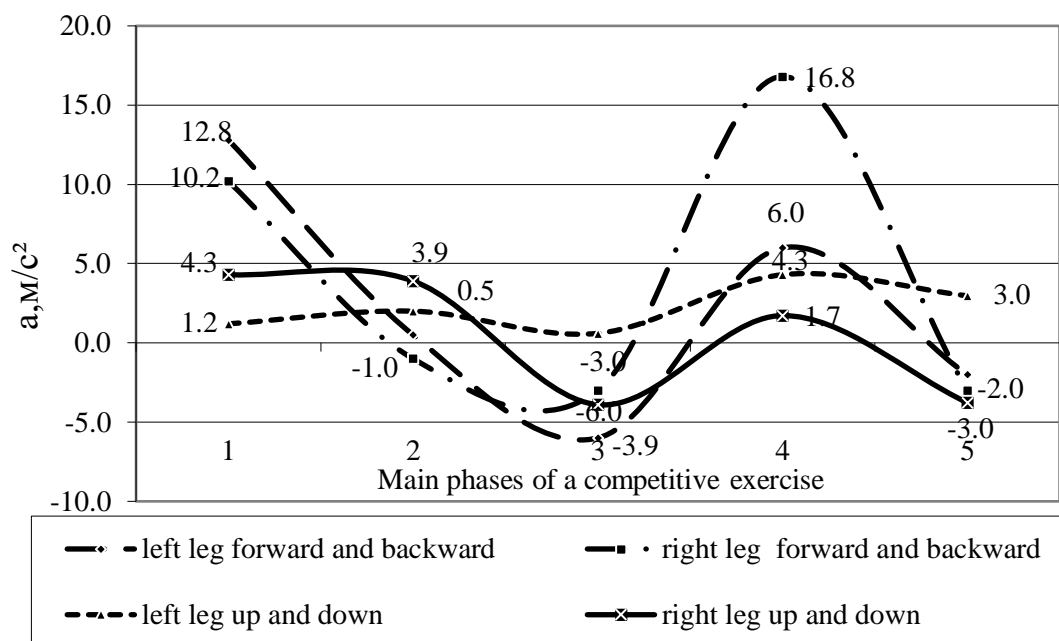


Fig. 4. Accelerometric readings of the legs of highly skilled athletes during the execution of the competitive exercise «Attack from a clinch»: 1 – entry into the attack zone – transition to a clinch; 2 – transition to a clinch – exit from the clinch; 3 – exit from the clinch – start of the strike; 4 – start of the strike – end of the strike; 5 – end of the strike – exit from the attack zone

Athletes cannot execute an effective strike without a quick arm grab combined with an immediate exit from the clinch. This is confirmed by the data obtained: acceleration in this phase is 3 m/s². The results of the study showed that athletes focus their efforts on exiting the clinch and attacking, using low-amplitude movement. This conclusion is supported by accelerometry readings in the up-down direction – 6 m/s².

Discussion

Our study is supported by evidence [6, 33, 36] that executing strikes, throws, and sweeps requires karate athletes to possess high coordination of movements, fine muscle sensation, precise spatial orientation, and a sense of rhythm, which places high demands on their level of technical proficiency.

It has been noted that changes to the rules of karate-do competitions and changes to sports equipment, which occur quite frequently, have significantly influenced the nature of karate athletes' technical preparedness [9]. Data [32] confirm that the increase in match

duration and the judges' stricter requirements for active combat have significantly affected the nature and ratio of movement patterns among skilled karateka.

We support the scientific approaches [7, 21, 23] that a rationally structured technical-tactical complex of actions allows for the optimal sequential linking of local offensive and defensive actions into a rational chain. This approach ensures that karateka achieve the desired end result of mastering a system of movements while taking into account the opponent's behavior.

Our study is consistent with the information [3, 14, 22] that a sense of rhythm, like other types of coordination abilities, can be purposefully trained by taking into account the specifics of the formation of motor skills, habits, and improved through repeated practice of exercises.

The data [19, 24] regarding the analysis of rhythmic patterns in competitive exercises performed by athletes training at the basic training stage have been expanded, with an emphasis on the rational distribution of effort during the execution of competitive exercises.

The information [2, 9, 27] has been expanded to show that technical preparedness cannot be considered in isolation but should be viewed as a component of a unified whole, in which technical decisions are closely interrelated with the athlete's physical, mental, and tactical capabilities, as well as with the specific conditions of the external environment in which the sporting action is performed.

Conclusions

The most important aspect of a karate athlete's technical preparedness is the ability to combine strikes, sweeps, throws, and maneuvers into a rational sequence of movements (technical-tactical complex) depending on the situation characteristic of a specific moment in competitive activity. A rationally structured technical-tactical complex of actions allows for the optimal sequential linking of local offensive and defensive actions into a rational sequence, which in turn ensures the achievement of the desired final result, taking into account the opponent's behavior.

The temporal characteristics of the "Sweep-forward-strike" and "Attack from a clinch" competitive exercises performed by karate-do athletes during the high-performance training phase were investigated; these should be used as a basis for assessing technical proficiency.

Prospects for further research. Based on the obtained data, a program will be developed to improve the rhythm of competitive exercises for various stages of athletic training for karate-do athletes. It is planned to determine the relationship between rhythm indicators and the competitive performance of highly skilled athletes.

Conflict of interest. The authors state that there is no conflict of interest

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