ORIGINAL ARTICLE

Prediction of success in taekwondo based on psychophysiological testing results

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Abstract

Background and Study Aim Predicting athletes' success is an integral part of sports monitoring. It enables the improvement of training quality and the differentiation of athletes according to skill level. Among the factors determining success and their informational value, psychophysiological indicators occupy an important place. The aim of this study was to justify and develop a method for predicting success in taekwondo based on psychophysiological testing results.

Material and Methods The study included 80 taekwondo athletes divided into age and skill groups. Group 1: 16 children aged 11–12 years, beginners; Group 2: 32 boys aged 14–16 years, sub-elite; Group 3: 28 adults aged 19–22 years, elite. Testing was performed using an iPad-based battery consisting of three tests: choice reaction, reaction to a moving object, and Go/No-go reaction. The battery simulated combat situations typical for taekwondo. The prediction model was based on Wald's sequential analysis with the calculation of predictive coefficients and informativeness for each indicator. Statistical analysis included descriptive statistics and Student's *t*-test to assess group differences.

Results A predictive table comprising 11 indicators with informativeness ⩾ 11.0 was created. Prediction involves assigning the corresponding coefficient to each result and summing until a decision threshold is reached. The threshold ±13 corresponds to a 95% probability ($p < 0.05$). Indicators with the highest informativeness were related to reaction time in the most complex stages of the tests, which required rapid adaptation to additional stimuli and changing conditions. Accuracy indicators from the Go/No-go test also contributed to the prediction, demonstrating the role of both speed and precision. The distribution of indicators across all three tests confirmed the multifactorial nature of taekwondo success prediction.

Conclusions The proposed methodology represents an objective and practical approach to forecasting competitive potential in taekwondo. It can be integrated into athlete selection systems and training monitoring programs, contributing to more effective talent identification and long-term performance development. The approach also offers the potential for adaptation to other combat sports that require rapid decision-making, high reaction speed, and precision under competitive conditions.

Keywords: taekwondo, prediction, success, functional tests, choice reaction, reaction to a moving object, Go/No-go reaction.

Introduction

High-performance achievement in combat sports is shaped by a combination of technical skills, tactical proficiency, physical conditioning, and psychological readiness. Within this multifaceted framework, the ability to anticipate and respond rapidly to dynamic situations in competition is critical for success. Psychophysiological characteristics, such as reaction time, selective attention, and decision-making speed, serve as integral indicators of an athlete's functional state and capacity to perform under pressure. Their systematic assessment offers opportunities to align training approaches with individual performance profiles, particularly in disciplines like taekwondo, where split-second decisions can determine the outcome of a match.

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Sports monitoring is a highly significant aspect of sports science [1, 2], as it plays a crucial role in optimizing athlete training, assessing adaptation processes, and preventing the development of adverse health changes [3]. Within the monitoring framework, prediction represents its most critical component, determining the overall effectiveness of the system. The main task of sports prediction is to determine the probability of success by analyzing the athlete's condition and identifying the qualities that are most relevant for competitive performance [2, 4].

The available literature confirms the importance of effective selection and success prediction, which are recognized as leading tasks in sports science [5]. These processes are commonly based on tests and functional trials, with the primary requirement being that prediction tools correspond to the specifics of the sport. Meeting this requirement substantially increases the accuracy and practical value of both prediction and selection in athletic contexts.

Previous research has analyzed the current state of sports prediction and identified several key problems [6]. These include the need for further development of theoretical foundations, a narrow range of research topics, insufficient thematic and interdisciplinary studies, and low accuracy and universality of existing models. In addition, a study [7] examined the potential for identifying talented athletes through prediction and conducted a meta-analysis that revealed the key components involved in talent identification. Notably, the "coach's instinct" emerged as a central factor in addressing predictive tasks and recognizing promising athletes.

The choice of tools for implementing sports prediction is a central factor in its effectiveness. Mathematical and statistical methods are often prioritized, as they enable more accurate forecasting compared to subjective expert assessments [8]. Studies have examined the characteristics of competitive activity in various types of martial arts [9, 10], with a particular emphasis on identifying the most frequently used technical and tactical actions. Such analysis makes it possible to evaluate the strengths and weaknesses of athletes' preparedness, which forms an integral part of predicting competitive success.

In another investigation [11], the application of different prediction and selection methods in sports was analyzed, leading the authors to conclude that combining multiple approaches substantially enhances the effectiveness of these procedures. A similar conclusion was reached in a separate study [12] that focused on the assessment of technical skills in the martial art of pencak silat. In this context, the quality of technical elements was shown to depend on a combination of physical and psychological components, underscoring the multifactorial nature of performance evaluation in martial arts.

A wide range of tests, trials, and methods is currently available for use in sports prediction. In the study by Podrihalo et al. [13], a comparative analysis of tools for selection, assessment of abilities, and evaluation of the potential of martial arts athletes was conducted. The findings indicated that hardware-based and simulation methods were the most effective, as they reflected the specific demands of the sport and offered practical convenience in their application. These results highlight the importance of choosing tools that combine both sport-specific relevance and ease of implementation.

Building on the idea of sport-specific predictors, another investigation [14] developed a prediction method for artistic swimming athletes, using anthropometric indicators, physical development indices, and functional test results as the basis for forecasting success. The main criterion for selecting predictors was their relevance and specificity to the given sport. This approach demonstrates how predictive models can be tailored to the unique physiological and technical demands of different athletic disciplines.

Similarly, research in martial arts has sought to identify key physical indicators for effective athlete selection. In the study by Romanenko et al. [15], a method based on physical development indices was proposed, analyzing the condition of elite kickboxing and wrestling athletes. This analysis revealed the most informative measures, including lower limb mass, arm strength indices, and upper limb segment ratio indicators, further emphasizing the role of precise and measurable characteristics in predicting athletic potential.

Building on the importance of selecting sport-specific and informative evaluation tools, particular attention has been given to the role of psychomotor and psychophysiological testing in martial arts. Studying the psychomotor abilities of martial arts athletes is an effective tool for assessing their functional state [16]. Such indicators can be recommended for use in sports selection, performance prediction, and monitoring of athletes' condition. The main requirements for the tests applied in this context are validity, informativeness, and sport-specific relevance. The validity of this approach has been supported by analyses of athletes in various martial arts [17], demonstrating that psychophysiological tests can identify qualities essential for achieving competitive success.

In taekwondo, psychophysiological test results make it possible to differentiate athletes according to their skill level [18]. A direct correlation has been established between the results of the tapping test and the duration of training in taekwondo athletes, reflecting an increase in the strength of nervous processes and positive changes in functional status under the influence of regular training loads. The superior psychomotor reaction performance of athletes at the highest skill level supports the recommendation of psychophysiological tests as tools for predicting performance and identifying success predictors.

The analysis of research findings confirms that psychophysiological testing offers valuable opportunities for differentiating athletes by skill level and identifying qualities linked to competitive success. The authors emphasize that incorporating these indicators alongside physical and technical performance measures enhances the precision and applicability of prediction models in martial arts. They stress that such integrated approaches provide a more complete understanding of an athlete's functional readiness and long-term potential. Nevertheless, there remains a need for further refinement of predictive methodologies tailored specifically to taekwondo, as this gap continues to limit the systematic use of psychophysiological data in athlete selection and performance forecasting.

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Thus, the available evidence confirms the suitability of psychophysiological tests for success prediction. However, no established methods currently exist for predicting success in taekwondo based on psychomotor reaction results. This led to the formulation of the following research question: *Can the results of psychophysiological testing predict the competitive success of taekwondo athletes?* The research hypothesis proposed that psychophysiological tests can be effectively used to predict success in taekwondo. Developing such methods would enable the individualization of training programs for athletes in this sport and enhance their effectiveness. Based on this premise, the present study aimed to justify and develop a method for predicting success in taekwondo using psychophysiological testing results.

Materials and Methods

Participants

Psychophysiological testing results from 80 taekwondo athletes were used as the basis for developing the methodology. Participants were divided into age and skill groups: Group 1 – 16 children aged 11–12 years, beginner athletes; Group 2 – 32 boys aged 14–16 years, sub-elite athletes; Group 3 – 28 adults aged 19–22 years, elite athletes. Age differences were naturally associated with variations in training duration and athletic skill level.

The study protocol and design were reviewed and approved by the Bioethics Committee of the Kharkiv State Academy of Physical Culture (Minute No. 10, 03.05.2025). All participants, or their legal guardians in the case of minors, provided written informed consent in accordance with the Declaration of Helsinki. Participant data were stored anonymously in a secure database to ensure confidentiality.

Inclusion/Exclusion Criteria

Inclusion criteria included the absence of injuries during the last six months and no medication use within the last month. Based on interview results, participants also reported no severe stress in the month preceding testing. The interval between the last training session and testing was 24 hours. Participants were advised to refrain from using electronic devices immediately prior to testing.

Study Design

All participants underwent testing using an original battery of tests administered on iOS-based iPad tablet computers. The testing took place in a sports hall, where microclimate parameters complied with hygiene standards. The overall research design is presented in Figure 1.

The battery included three tests: choice reaction, reaction to a moving object, and 'Go/No-go' reaction. The choice reaction test was assessed by reaction time (ms) across four testing stages and by the number of errors (absolute values) at each stage. The reaction to a moving object was evaluated based on the total reaction time for the entire test, reaction time at three specific stages, and the proportion of accurate, early, and delayed reactions (%). The 'Go/No-go' reaction was assessed by simultaneous reaction time of the right and left hands (ms), separate reaction times for each hand (ms), and the proportion of errors in each case (%).

The validity of these methods has been confirmed in previous studies [19, 20]. All procedures were non-invasive and posed minimal risk to participants.

Statistical analysis

The obtained data were analyzed using a licensed version of MS Excel 2019 (version 2506). The test results followed a normal distribution; therefore, descriptive statistics (mean and standard deviation) were used for their characterization. Differences between groups were assessed using Student's *t*-test.

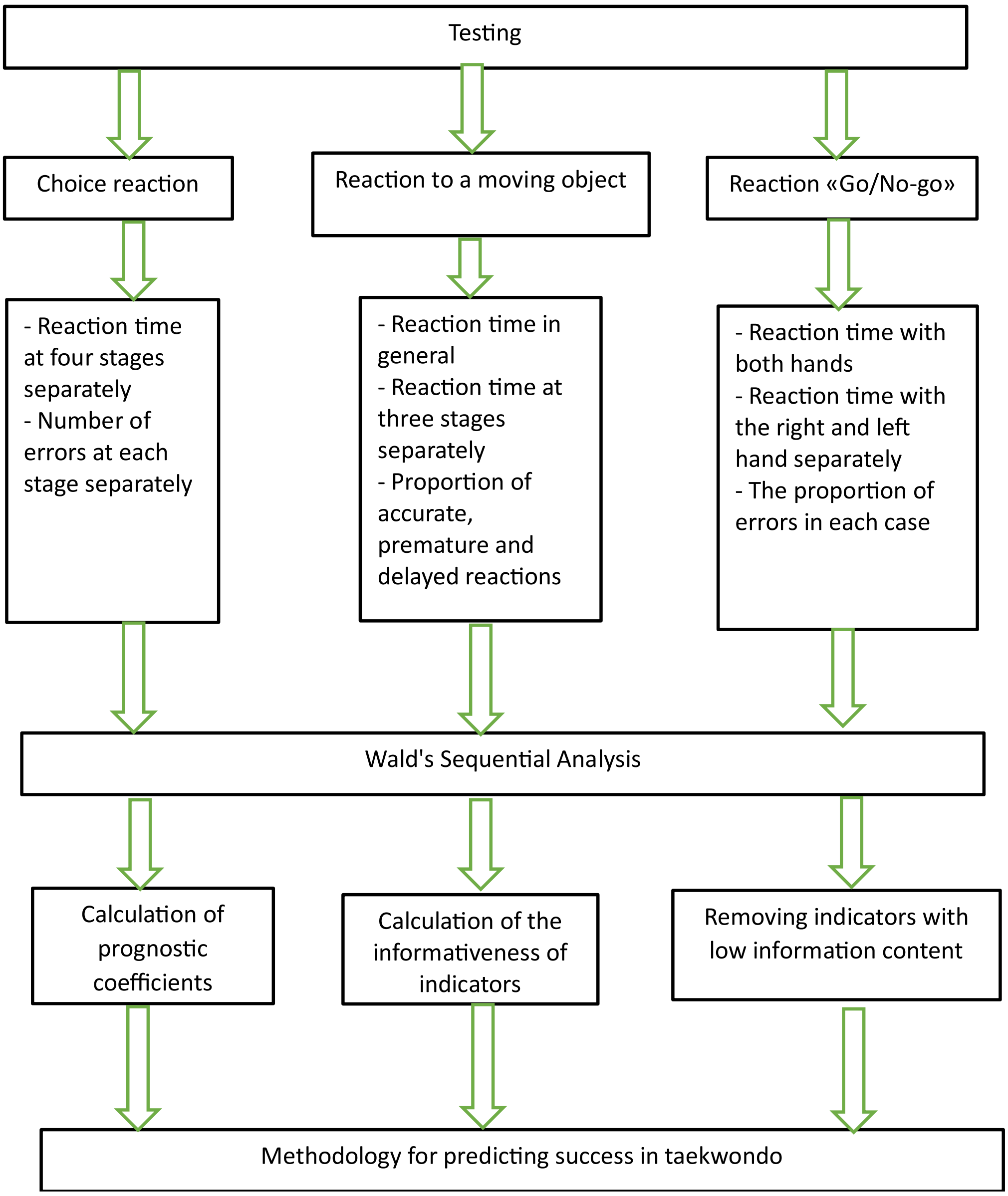

Figure 1. Scheme of the study

Wald's sequential analysis was applied as the prediction tool [21]. This method involves constructing a predictive table containing the predictive coefficients of the indicators and their informativeness. The predictive coefficients were calculated using the following formula:

$$PC = 10 \cdot \log \frac{(p_1 \cdot D_1/S)}{(p_2 \cdot D_2/S)} \tag{1}$$

where:
- PC – predictive coefficient;
- S – total number of participants in the group;
- D_1 – number of participants in Group 1 with a value above the group's average;
- D_2 – number of participants in Group 2 with a value above the group's average;
- p_1 – probability of exceeding the average value in Group 1;
- p_2 – probability of exceeding the average value in Group 2.

Predictive coefficients for values lower than the average were calculated in the same way.

The informativeness (I) was calculated using the formula:

$$I = PC \cdot 0.5 \cdot [(p_1 \cdot D_1/S) - (p_2 \cdot D_2/S)] \tag{2}$$

where: I – the informativeness, and the remaining designations are the same as in formula (1).

Results

The test results are presented in Tables 1–3. The results in Table 1 confirm the influence of age and skill level on choice reaction performance. The most experienced athletes demonstrated the shortest reaction times, whereas novice athletes had the longest. A similar hierarchy was observed for accuracy, with experienced athletes making the fewest errors during test execution.

The results in Table 2 demonstrate significant differences in reaction to a moving object among taekwondo athletes of varying skill levels. Elite athletes achieved the best performance both in individual stages and in the overall test, while novice athletes recorded the poorest results, and teenage sub-elite athletes occupied an intermediate position. The gradual increase in task complexity during the second and third stages of the test allowed for clear differentiation by skill level. In contrast to beginners, elite athletes adapted more rapidly to changes in testing conditions.

The results in Table 3 indicate performance differences between taekwondo athletes in the Go/No-go test. Elite athletes demonstrated faster reaction times compared to sub-elite athletes. At the same time, the absence of significant differences in accuracy indicators suggests a comparable skill level between the groups in terms of error control.

Thus, the test results confirmed significant differences in the psychophysiological indicators of taekwondo athletes with different skill levels. This served as the basis for developing a methodology for predicting success in this sport. The developed methodology is presented in Table 4.

Table 4 was constructed according to the requirements of sequential analysis. It contains psychophysiological indicators, predictive coefficients for the presence and absence of the specified result, and the informativeness of each indicator. These values were calculated based on the testing results of taekwondo athletes representing different skill levels.

The indicators in Table 4 are listed in descending

Table 1. Choice reaction results of taekwondo athletes with different skill levels

Indicators	Group 1 (M ± SD)	Group 2 (M ± SD)	Group 3 (M ± SD)
Reaction time, first stage (ms)	853.88 ± 69.06[1,2]	723.06 ± 88.28	663.88 ± 55.67[1]
Number of errors, first stage (abs)	0.13 ± 0.13	0.41 ± 0.12	0.63 ± 0.26
Reaction time, second stage (ms)	876.50 ± 89.02[1,2]	749.53 ± 104.15	666.94 ± 66.38[1]
Number of errors, second stage (abs)	0.13 ± 0.13	0.24 ± 0.14	0.00 ± 0.00[3]
Reaction time, third stage (ms)	1070.38 ± 145.16[1,2,3,4]	922.53 ± 101.13[3,4]	842.88 ± 87.57[1,3,4]
Number of errors, third stage (abs)	0.25 ± 0.25	0.12 ± 0.08[3]	0.06 ± 0.06
Reaction time, fourth stage (ms)	1049.50 ± 157.86[2,3,4]	965.35 ± 122.34[3,4]	878.31 ± 103.58[1,3,4]
Number of errors, fourth stage (abs)	0.13 ± 0.13	0.18 ± 0.10	0.13 ± 0.09[3]

Note. [1] – significant differences with Group 2 ($p < 0.05$); [2] – significant differences with Group 3 ($p < 0.05$); [3] – significant differences with Stage 1 ($p < 0.05$); [4] – significant differences with Stage 1 ($p < 0.05$).

Table 2. Reaction to a moving object in taekwondo athletes with different skill levels

Indicators	Group 1 (M ± SD)	Group 2 (M ± SD)	Group 3 (M ± SD)
Reaction time, entire test (ms)	34.58 ± 7.00[1,2]	29.99 ± 7.34[2]	26.46 ± 5.94
Reaction time, first stage (ms)	33.32 ± 10.13[2]	32.16 ± 10.53[2]	26.99 ± 7.70
Reaction time, second stage (ms)	33.73 ± 8.90[2]	29.27 ± 9.60	27.38 ± 8.20
Reaction time, third stage (ms)	36.75 ± 10.17[1,2]	28.50 ± 9.62	24.97 ± 8.43
Early reactions (%)	45.73 ± 12.45	54.62 ± 6.54	51.07 ± 7.54
Delayed reactions (%)	47.96 ± 12.49	38.72 ± 6.40	41.13 ± 7.42
Accurate reactions (%)	6.31 ± 6.08	6.66 ± 3.27	7.80 ± 4.04

Note. [1] – significant differences with Group 2 ($p < 0.05$); [2] – significant differences with Group 3 ($p < 0.05$).

Table 3. 'Go/No-go' reaction results of taekwondo athletes with different skill levels

Indicators	Group 1 (M ± SD)	Group 2 (M ± SD)
Reaction time, all values, left and right hands (ms)	352.92 ± 30.89[1]	339.42 ± 21.71
Total error rate (%)	26.08 ± 7.22	15.83 ± 6.45
Reaction time, left hand (ms)	349.55 ± 34.76[1]	333.12 ± 26.90
Error rate, left hand (%)	23.25 ± 3.87	18.17 ± 6.82
Reaction time, right hand (ms)	358.59 ± 29.24	347.08 ± 20.78[2]
Error rate, right hand (%)	31.53 ± 7.64	14.11 ± 6.15

Note. [1] – significant differences with Group 2 ($p < 0.05$); [2] – significant differences with the left hand ($p < 0.05$).

Table 4. Method for predicting the success of taekwondo athletes based on psychophysiological indicators

Indicators	Predictive coefficients	Informativeness
	Presence	Absence
Reaction time to a moving object in the third stage ⩽ 24 ms	10.23	−4.39
Choice reaction time in the second stage ⩽ 666 ms	6.02	−2.43
Choice reaction time in the third stage ⩽ 842 ms	6.02	−2.43
Choice reaction time in the fourth stage ⩽ 878 ms	6.02	−2.43
Reaction time to a moving object, entire test ⩽ 26 ms	6.75	−3.30
Choice reaction time in the first stage ⩽ 663 ms	4.77	−1.46
Reaction time to a moving object in the second stage ⩽ 27 ms	5.15	−3.23
"Go/No-go" reaction error rate, right hand ⩽ 14%	2.50	−2.38
Reaction time to a moving object in the first stage ⩽ 26 ms	2.60	−2.02
Total "Go/No-go" error rate ⩽ 15%	1.34	−1.59
"Go/No-go" reaction time, all values, both hands ⩽ 339 ms	1.27	−1.92

order of informativeness. Arranging the indicators in this way minimizes the number of steps in the prediction procedure and reduces the likelihood of errors. An informativeness value below 11.0 is considered insignificant; therefore, such indicators were excluded from the table.

The prediction procedure is as follows: the subject completes a series of psychophysiological tests – choice reaction, reaction to a moving object, and 'Go/No-go' reaction. From the obtained results, the indicators listed in the table are identified. If a result matches the value specified in the table, the corresponding presence coefficient is used; otherwise, the absence coefficient is applied. The prediction process involves sequentially summing the selected coefficients until the threshold value is reached or all indicators in the table have been processed.

The permissible error is set at 5%, corresponding to a threshold value of ±13 points. This level of error is commonly used in research as it reflects a 95% probability. Reaching a threshold of +13 indicates that the athlete has strong prospects in taekwondo ($p < 0.05$). Conversely, reaching a threshold of −13 indicates that the athlete has no prospects in taekwondo ($p < 0.05$). If neither threshold is reached after processing all indicators in the table, the prediction is considered inconclusive, and further assessment is required.

Discussion

The aim of this study was to justify and develop a method for predicting the success of taekwondo athletes based on psychophysiological testing results. The proposed methodology incorporated three key tests: choice reaction, reaction to a moving object, and 'Go/No-go' reaction, and applied Wald's sequential analysis to calculate predictive coefficients and indicator informativeness. The findings confirmed significant differences in psychophysiological indicators among athletes of different skill levels, with elite athletes demonstrating superior reaction times and accuracy across multiple test stages. The resulting predictive model, constructed using the most informative indicators, provides an objective approach for assessing competitive potential in taekwondo.

Multimedia technologies represent a promising direction in sports monitoring. Cognitive-oriented training, virtual and augmented reality, computer programs, and simulation devices that reproduce specific game situations are among the modern technological tools used in this context [22].

The rapid development of multimedia technologies has facilitated their integration into many fields, including sports. A study [23] demonstrated that these technologies can significantly improve the performance of taekwondo athletes. They enable the adaptation of complex information about the preparedness of martial artists for easier perception and enhance the quality of feedback during monitoring.

Digital technologies support the principle of feedback in sports monitoring [24], which plays a decisive role in athlete training [25]. Without the use of multimedia tools, it is difficult to ensure timely and objective feedback. High-quality feedback is therefore a necessary and sufficient condition for effective sports monitoring, and its implementation can lead to substantial improvements in the athletes' training process [26]. Athletes in martial arts employ various strategies to recognize and anticipate their opponent's movements. Regardless of the specific approach, each strategy relies on the fastest possible analysis of the opponent's actions, which underlines the importance of a high level of psychomotor abilities [16].

Peripheral vision is an important factor during a sports match [27]. It is widely accepted that skilled athletes differ from non-athletes in their capacity to effectively process and interpret visual information.

Throughout their professional careers, they acquire and refine strategies to optimize this process [28, 29]. The effectiveness of such strategies depends largely on the tools used to assess and develop them, which often include specialized tests and functional trials.

The available results informed the selection of tests for prediction in the present study. The proposed battery consisted of three assessments: choice reaction, reaction to a moving object, and Go/No-go reaction. These tests are specific to striking martial arts and simulate situations encountered during fights. Their specificity and informativeness make it possible to identify functional characteristics that are essential for achieving success. A rapid response to various stimuli increases the likelihood of executing successful actions during a match, thereby improving the chances of victory.

The test algorithms provide objective and representative results. The data follow a normal distribution, which is essential for comparative analysis. The short duration of the tests ensures that the testing process does not significantly influence performance levels. The tests consist of a sequence of tasks with increasing complexity, which allows for the assessment, to a certain extent, of the characteristics of athletes' nervous systems [16, 17].

The accuracy of this approach is supported by findings from the literature. A fundamental requirement for selecting indicators for prediction is their relevance to the development of specific skills and abilities. Litwiniuk et al. [30] suggested assessing coordination and the ability to maintain balance as part of predicting success in martial arts athletes. In their study, tolerance to body balance disturbances was evaluated in the context of alpine skiing training. The assessment tool was a jump test with body rotation in both directions, and martial arts athletes demonstrated a higher level of tolerance compared to other groups.

An important criterion for prediction is the specificity of indicators to the type of martial art. In one study [31], a comparative analysis of the condition of elite martial arts athletes was conducted using physical development indices. The analysis identified features determined by the specifics of martial arts, with limb segment ratio indices proving to be the most informative. The validity of using such specialized indices to monitor the functional state of athletes was confirmed.

The design of the present study, which divided participants by age and skill level, is widely used in sports science and meets the requirements for predictive research. The division into three groups was based on the anatomical and physiological characteristics of development. The first group comprised prepubertal participants, whose bodies are preparing for puberty and undergoing significant metabolic changes. The second group included athletes in puberty, a stage characterized by pronounced physiological changes. The third group consisted of adults whose physical condition is relatively stable.

Identifying a group of elite athletes makes it possible to determine the qualities that have enabled them to achieve success. In one study [18], this approach confirmed the optimization of the functional state of taekwondo athletes during training. Similar results were reported in another study [32], which also analyzed the condition of elite athletes. The findings confirmed a relationship between training organization and metabolic parameters in elite taekwondo athletes. Determining physical development indices and somatotype components is an important tool for monitoring athletes' condition.

An important aspect of prediction is the choice of method, as sports forecasting relies on a variety of approaches and analytical techniques. Holmes et al. [33] proposed a methodology for predicting the results of mixed martial arts competitions by analyzing data from publicly accessible websites to assess fighters' skills. In their work, the competition was modelled as an actual fight using Markov chains, which significantly increased prediction accuracy and demonstrated the potential of mathematical modelling for performance forecasting.

Velichkov et al. [34] applied the interview method for prediction, conducting multiple interviews with athletes in boxing, martial arts, and tennis. The findings supported the assumption that interviewing an athlete before a match can provide valuable insight into the likely outcome. This approach highlights the relevance of psychological and self-assessment factors, which may complement quantitative data in predictive models.

It has also been proposed [10] to use logistic regression models for predicting performance in mixed martial arts. Cross-validation and discriminant analysis of the model confirmed its higher predictive probability compared to baseline models. This statistical approach demonstrates that advanced regression techniques can outperform more simplistic methods when sufficient high-quality input data are available.

In the present study, Wald's sequential analysis was selected as the predictive tool because it meets the specific requirements of the research task. The algorithm of this method is consistent with the logic of prediction studies and allows for step-by-step decision-making. A comparison of groups with different skill levels made it possible to determine the proportion of athletes whose results were above or below the average, and predictive coefficients and informativeness values were then calculated based on these findings.

The effectiveness of sequential analysis for solving predictive tasks has been demonstrated in previous studies, including the development of prediction methods in artistic swimming [14] and the creation of a selection method for kickboxing at the initial training stage [15]. These examples confirm the broad applicability of the method in different sports contexts. Its adaptability and ability to incorporate multiple indicators make it a valuable tool for objective and evidence-based athlete evaluation.

Another important advantage of the method used is its flexibility in selecting the desired prediction probability. The Wald method makes it possible to set a probability range from 80% to 99.9%, which corresponds to predictive thresholds between 6 and 30 points, respectively. In the present study, we selected a probability value of $p < 0.05$, corresponding to 95%, with a threshold value of ±13 points. The same threshold values have been applied in previous studies [14, 15], which supports the methodological consistency of our approach. This choice ensured an optimal balance between prediction accuracy and practical applicability in the context of taekwondo performance forecasting.

Obtaining an effective result depends on the number of indicators included in the table. The analysis identified 24 indicators that could potentially be used for prediction. However, the optimal number of criteria ranges from 7 to 10, and the minimum informativeness was set at 11.0 to reduce the total number. Indicators with low informativeness do not significantly influence the prediction outcome. As a result, 11 indicators were selected, ensuring both sufficient informativeness and practical convenience of the methodology.

Analysis of the indicator hierarchy in the table makes it possible to assess the significance of individual tests. The table contains four indicators related to choice reaction, four related to reaction to a moving object, and three related to the Go/No-go reaction. This confirms that all three tests contribute meaningfully to prediction. However, their relative contribution should be evaluated by considering the position of each indicator in the table, which is determined by its informativeness.

The most informative indicator was the reaction time to a moving object in the third stage of testing. This stage is the most demanding because it introduces additional objects, chaotic movements, and parameter changes that significantly interfere with reaction execution, thereby increasing task complexity. Performance at this stage demonstrates the participant's ability to counteract interfering factors.

The next three indicators reflect choice reaction performance in the second, third, and fourth stages of testing, all of which have identical informativeness and predictive coefficient values. These stages illustrate the progressive increase in task complexity during testing. The complexity is increased by introducing counteracting symbols in stage 2, modifying the shape of the reaction object in stage 3, and combining complex-shaped objects with symbols that interfere with perception in stage 4. Collectively, these three indicators assess not only concentration and resistance to distracting stimuli but also the ability to rapidly shift attention to objects that differ substantially from previous stimuli.

These four indicators are characterized by maximum informativeness values exceeding 100. The presence coefficients are such that fulfilling these four indicators yields more than 13 points, which corresponds to a positive prognosis. The next four indicators have an average informativeness level ranging from 61.33 to 34.23. Importantly, these indicators represent all three tests used in the study, confirming the complexity of the prognostic assessment. This group includes reaction time to a moving object for the entire test, choice reaction time in the first stage, reaction time to a moving object in the second stage, and the proportion of errors when performing the 'Go/No-go' test with the right hand. Compared to the previous criteria, these reaction time indicators are more general in nature. In addition to reflecting overall performance in psychophysiological tests, they demonstrate the ability of athletes to quickly become engaged in work and reach optimal working condition. The last criterion in this group characterizes accuracy in performing the 'Go/No-go' test tasks and illustrates coordination and balance within the nervous system.

The final group consists of three indicators with informativeness values below 20. The predictive coefficients for these measures are also relatively small, indicating a limited impact on the overall prognosis. Two of these indicators reflect the reaction time to a moving object in the first stage of testing and the 'Go/No-go' reaction time when using the left and right hands simultaneously. The third criterion is the total percentage of 'Go/No-go' reaction errors, representing overall task accuracy. Although these indicators are of minor importance for solving the prognostic task, they contribute to a more comprehensive understanding of the athletes' test performance.

The inclusion of indicators that illustrate task accuracy highlights the specificity of the tests used for martial arts. Success in martial arts depends not only on speed but also on the quality of certain actions. In this context, quality is assessed by action accuracy, defined as the minimal number of errors. The accuracy indicators in this study were derived from performance in the Go/No-go test, which evaluates the ability to react appropriately while ignoring irrelevant stimuli. In martial arts, this skill can be interpreted as the capacity to avoid reacting to an opponent's feints. Accurate execution of this test serves as an important predictor of success.

The comparative analysis of athletes' conditions at the beginner, sub-elite, and elite training levels represented a form of research prediction. Since elite athletes have reached their maximum potential, it can be concluded that their psychomotor characteristics exert the greatest influence on their sporting achievements and thus play a central role in predicting success. Another important implication of the results is the potential to use psychophysiological testing outcomes at the initial training stage to guide athlete selection and assess the long-term prospects of taekwondo practitioners.

Limitations of this study

The primary limitation of this study is the exclusive use of psychophysiological tests. While effective, the methodology could be further improved by integrating physical and psychological variables in future adaptations. A promising direction for enhancing prediction quality would be the inclusion of strength and flexibility tests, as well as assessments of physical development characteristics.

Conclusions

This study substantiated and developed a methodology for predicting the success of taekwondo athletes. The methodology incorporates the results of choice reaction, reaction to a moving object, and Go/No-go reaction tests. These tests are specific to taekwondo, simulate combat situations, and are both valid and informative. The selected indicators reflect the time required to complete the tests and individual test tasks, as well as performance accuracy, measured by the proportion of errors. This combination enables a comprehensive assessment of athletes' functional state. The prediction outcome is a conclusion regarding the athlete's prospects or lack thereof in taekwondo. The developed method offers an objective and effective tool for predicting athletic success based on reaction test performance. It is suitable for talent identification and monitoring in taekwondo. Implementation of this methodology in practice may contribute to increased training effectiveness and improved athlete performance in this sport.

Conflict of Interest

One of the authors, Sergii Iermakov, serves as the Editor-in-Chief and Publisher of this journal, and another author, Leonid Podrigalo, is a member of the Editorial Board. To ensure an objective review process, the manuscript was managed by an independent editorial board member, and the peer review was conducted by external reviewers without affiliations to the authors. The Editor-in-Chief and the Editorial Board member did not participate in the review or editorial decision-making process for this manuscript. All other co-authors declare no conflict of interest regarding this publication.

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