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A COMPREHENSIVE MONITORING METHODOLOGY FOR THE TRAINING SYSTEM OF ELITE PARA-TAEKWONDO ATHLETES

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ABOUT ARTICLE

Key words: para-taekwondo; comprehensive monitoring methodology; training system; physical preparedness; technical-tactical indicators; psychological readiness; competition period; Paralympic sport; athlete classification; performance assessment.

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Abstract: This article presents a five-stage comprehensive monitoring methodology specifically designed for the training system of elite para-taekwondo athletes competing at national and international levels. The study was conducted between 2022 and 2024 and involved 18 elite para-taekwondo athletes (8 female, 10 male; aged 18–32 years) classified under World Taekwondo Para regulations across the K40, K44, and K46 impairment categories. During the study, an integrated set of indicators was developed to enable the simultaneous assessment of physical, technical, tactical, and psychological preparedness within a unified evaluative framework. Physical fitness was assessed through standardized sport-pedagogical testing protocols, while technical readiness was evaluated using high-speed video analysis at up to 240 frames per second, enabling precise biomechanical measurement of movement accuracy and coordination. Tactical preparedness was examined through simulation-based chronometric testing, with a threshold standard of 1.5 seconds established for competitive decision-making response time — an indicator found to correlate significantly with match outcomes ($r = 0.71$, $p < 0.01$). Psychological readiness was evaluated using validated psychodiagnostic instruments, including the SAQ questionnaire and the

Introduction. Para-taekwondo is a combat sport included in the Paralympic Games programme and specifically designed for athletes with physical impairments. Its distinctive characteristics demand a unique approach to monitoring athlete preparation. The diverse physical capabilities, impairment classifications, and individual features of para-taekwondo athletes render the direct application of conventional monitoring methodologies frequently ineffective.

In recent years, the imperative to evaluate not only physical fitness, but also technical precision, tactical acuity, and psychological stability within a unified framework has become increasingly pressing in order to achieve high performance in para-sport. Nevertheless, a scientifically developed comprehensive monitoring methodology that fully encompasses the competition period and is specifically tailored for elite para-taekwondo athletes remains insufficiently addressed in the scholarly literature.

The purpose of this study is to scientifically substantiate and validate the effectiveness of a five-stage comprehensive monitoring methodology for the training system of elite para-taekwondo athletes.

Methods. The problem of monitoring sports training has been investigated in numerous domestic and international scholarly works. Matveev (1991) provided a detailed description of the principal functions of monitoring in the management of sports training, categorizing it into preliminary, current, and final monitoring types. Platonov (2015), within the framework of sports training theory, identified the structural components of the monitoring system and experimentally validated its influence on competitive outcomes.

In the field of para-sport, Tweedy and Vanlandewijck (2011) developed a functional classification system and emphasized the necessity of establishing distinct assessment criteria for each impairment group. Martin (2017) investigated the psychological preparation of para-athletes and identified the decisive influence of motivation and self-confidence on competitive success.

Regarding taekwondo, Falco et al. (2012) analyzed the tactical structure of competitive activity and quantified the role of decision-making speed in achieving victory. Notwithstanding these contributions, research specifically dedicated to comprehensive monitoring

methodologies in para-taekwondo remains insufficient—a gap that underscores the scientific novelty and practical significance of the present study.

The study was conducted between 2022 and 2024. Eighteen elite para-taekwondo athletes (8 female, 10 male; aged 18–32 years; classified as K40, K44, and K46 under World Taekwondo Para regulations) who participated in national and international competitions were involved in the research.

The following methods were employed throughout the study: pedagogical observation; sport-pedagogical testing; high-speed video analysis (up to 240 frames per second); psychodiagnostic methods (SAQ questionnaire; Spielberger-Hanin anxiety scales); and expert evaluation involving coaches and sports psychologists. All data were subjected to statistical processing using SPSS 26.0, with mean values (M), standard deviations (σ), Student's t-tests, and correlation analysis applied.

The monitoring methodology comprises five sequential stages, covering the period from six to eight weeks prior to competition through to one to two weeks following the competition. For each stage, control objects, criteria, measurement methods, and expected outcomes were explicitly defined.

Results and discussion. A comprehensive monitoring methodology was developed for the training system of elite para-taekwondo athletes. The methodology is detailed in Table 1.

Table 1.

Five-Stage Comprehensive Monitoring Methodology for Elite Para-Taekwondo Athletes' Training System

Stage	Timefr ame	Main Objective	Control Object	Criteria	Measurement Method	Standard	Expected Result
Stage I	6–8 weeks before	Baseline diagnostics; identify weaknesses	Physical fitness	Endurance, strength, speed	Tests, timely measurement	≥ 7.0 pts	Weak areas identified
			Technical readiness	Movement accuracy, coordination	Video analysis, expert scoring	≥ 7.5 pts	Technical deficiencies listed
			Psychological state	Motivation, stress resistance	Questionnaire, observation	≥ 7.0 pts	Individual development plan drafted
Stage II	4–6 weeks	Develop technical-tactical indicators; monitor dynamics	Technical accuracy	Movement quality, error count	Video analysis (240 fps)	≥ 8.0 pts	Technical accuracy +15–25%

Stage	Timefr ame	Main Objective	Control Object	Criteria	Measurement Method	Standard	Expected Result
			Tactical speed	Decision-making time	Simulation, chronometry	≤ 1.5 sec	Speed +20–30%
			Training load	Individual load adaptation	Weekly monitoring	≥ 90% of plan	Efficiency +25–35%
Stage III	2–3 weeks before	Comprehensiv e assessment; finalize competition strategy	Comprehensi ve evaluation	Sum of all criteria	Full diagnostics	≥ 80%	Readiness level established
			Psychological stability	Stress, motivation, confidence	Questionnaire, observation test	≥ 7.0 pts	Psychological readiness confirmed
			Tactical strategy	Individual tactical instructions	Coach interview	Confirmed	Competition plan ready
Stage IV	Competi tion period	Operative control; adapt strategy based on opponent analysis	Operative state	Physical & psychological status	Pre/post-match assessment	Stable	Result efficiency +10–20%
			Opponent analysis	Tactical adaptation speed	Video surveillance, analysis	Operative	Tactical plan adapted
Stage V	1–2 weeks after	Final analysis; planning for next cycle	Final report	Achievements & deficiency analysis	Analysis protocol	Full report	Future plan developed
			Methodology refinement	System update recommendation s	Group discussion	Recommendat ions	Methodology improved

As illustrated in Table 1, the developed methodology encompasses five sequential stages. Stage I, implemented six to eight weeks prior to competition, functions as baseline diagnostics and is directed towards identifying the athlete's weaknesses and formulating an individual development plan. At this stage, a normative threshold of 7.0 points was established for physical fitness indicators, and 7.5 points for technical preparedness.

Stage II, conducted over a four-to-six-week period, is directed at developing technical-tactical indicators. During this phase, high-speed video analysis at 240 frames per second facilitated a 15–25% improvement in technical accuracy. A threshold standard of 1.5 seconds was set for tactical decision-making time; this indicator was found to directly influence competitive outcomes ($r = 0.71$, $p < 0.01$).

Stage III is dedicated to finalizing the competition strategy and consolidating psychological stability. Stage IV—the competition period itself—incorporates operative monitoring and opponent analysis; at this stage, the capacity for rapid tactical adaptation

proves decisive. Stage V serves as the final analytical phase, providing the foundation for planning the subsequent training cycle.

The effectiveness of the methodology was demonstrated in the experimental group: competitive results improved by an average of 18.4% compared to the control group ($p < 0.05$). Particularly notable gains were recorded in technical accuracy (+21.3%) and tactical decision-making speed (+26.7%).

Conclusion. Based on the conducted research, the following conclusions were drawn:

1. The five-stage comprehensive monitoring methodology developed for elite para-taekwondo athletes enables an integrated assessment of physical, technical, tactical, and psychological preparedness within a unified system.

2. The establishment of scientifically grounded criteria and standards for each stage affords coaches the opportunity to objectively track the developmental dynamics of athletic form.

3. The practical implementation of the methodology yielded a statistically significant 18.4% improvement in competitive outcomes in the experimental group ($p < 0.05$), thereby confirming its high effectiveness.

4. The developed methodology is adaptable and applicable to para-taekwondo athletes across varying age groups and qualification levels.

Future research should focus on analyzing this methodology separately across different impairment classification groups and evaluating its long-term effectiveness over extended training cycles.

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