



Physical Culture and Sports

UDC 796.853.4

DOI <https://doi.org/10.5281/zenodo.19502531>

**Training process management of taekwondo athletes in Poomsae
discipline: pedagogical control and load planning**

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Accepted: 11.03.2026 | Published: 30.03.2026

Abstract. Aim. To develop and scientifically substantiate a system for managing training loads of highly qualified taekwondo athletes at the pre-competition preparation stage, considering the specifics of competitive activity in Poomsae format. Methods. The study employed a complex of methods: analysis and generalization of scientific-methodological literature, pedagogical observations, pedagogical experiment, mathematical statistics methods. For fitness diagnostics, technical mastery testing (forms execution scoring according to World Taekwondo criteria), static balance test (stance holding time), flexibility test, R.M. Baevsky stress index, tapping test for evaluating nervous processes speed, tremorometry for determining limb stability, and attention concentration test were used. The experimental study involved 18 highly



qualified athletes aged 17-21 years during a four-week pre-competition mesocycle. Additionally, an experimental study involving 20 athletes was conducted to examine weight reduction effects. Results. The optimal structure of the pre-competition mesocycle for Poomsae was determined, consisting of four microcycles: basic (35% of total load volume), special technical (35%), modeling (20%), and introductory (10%). It was established that weight reduction by 2.5-3 kg (3.5-4.1% of body weight) improves strength-to-weight ratio without loss of stability, while reduction by 4-5 kg or more leads to deterioration of coordination and static balance. After the four-week pre-competition preparation stage, athletes' technical mastery indicators improved by an average of 8-12% ($p < 0.05$): average score for forms execution increased from 8.4 to 9.1, stance holding time increased from 45.0 to 52.5 seconds, stress index decreased from 61.0 to 54.0 conventional units. Conclusions. The developed methodology for planning training loads allows effective management of taekwondo Poomsae athletes' preparation at the pre-competition stage. Focused development of technical precision, static stability, and psychological concentration is a key factor for competitive success. The proposed battery of pedagogical control tests ensures timely correction of the training process and achievement of planned fitness indicators.

Keywords: taekwondo, Poomsae, pre-competition preparation, training process management, technical mastery, pedagogical control, training loads, static balance.

**Управління тренувальним процесом спортсменів тхеквондо у
дисципліні Poomsae: педагогічний контроль та планування навантаження**

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Анотація. Мета. Розробити та науково обґрунтувати систему управління тренувальними навантаженнями тхеквондистів високої кваліфікації на етапі передзмагальної підготовки з урахуванням специфіки змагальної діяльності у напрямку Roomsae. Методи. У дослідженні застосовано комплекс методів: аналіз і узагальнення науково-методичної літератури, педагогічні спостереження, педагогічний експеримент, методи математичної статистики. Для діагностики підготовленості використано тестування технічної майстерності (оцінка виконання форм за критеріями World Taekwondo), тест на статичну рівновагу (час утримання стійки), тест на гнучкість, індекс напруження Р.М. Баєвського, теплінг-тест для оцінки швидкості нервових процесів, треморометрію для визначення стабільності кінцівок, тест концентрації уваги. Експериментальне дослідження проводилося за участі 18 спортсменів віком 17-21 року високої кваліфікації протягом чотиритижневого передзмагального мезоциклу. Додатково для вивчення впливу зниження ваги проведено експериментальне дослідження за участі 20 спортсменів. Результати. Визначено оптимальну структуру передзмагального мезоциклу для Roomsae, що складається з чотирьох мікроциклів: базового (35% загального обсягу навантаження), спеціально-технічного (35%), модельного (20%) та підвідного (10%). Встановлено, що зниження ваги на 2,5-3 кг (3,5-4,1% від маси тіла) покращує співвідношення сили до ваги тіла без втрати стабільності, тоді як зниження на 4-5 кг і більше призводить до погіршення координації та статичної рівноваги. Після чотиритижневого етапу передзмагальної підготовки показники технічної майстерності спортсменів покращилися в середньому на 8-12% ($p < 0,05$): середній бал за виконання форм зріс з 8,4 до 9,1, час утримання стійки збільшився з 45,0 до 52,5 сек, індекс напруження знизився з 61,0 до 54,0 умовних



одиниць. Висновки. Розроблена методика планування тренувальних навантажень дозволяє ефективно управляти підготовкою тхеквондистів-помсегістів на передзмагальному етапі. Акцентована спрямованість на розвиток технічної точності, статичної стабільності та психологічної концентрації є ключовим фактором успішності змагальної діяльності. Запропонована батарея тестів педагогічного контролю забезпечує своєчасну корекцію тренувального процесу та досягнення запланованих показників підготовленості.

Ключові слова: тхеквондо, Poomsae, передзмагальна підготовка, управління тренувальним процесом, технічна майстерність, педагогічний контроль, тренувальні навантаження, статична рівновага.

INTRODUCTION

The current stage of Olympic taekwondo development is characterized by clear differentiation of disciplines into Kyorugi (sparring) and Poomsae (formal patterns). While in Kyorugi the priority is physical contact combat with high intensity of competitive activity, in Poomsae performance success depends primarily on technical precision of element execution, movement rhythm, static balance, and aesthetic component of performance. Consequently, training process management in Poomsae requires a fundamentally different approach from sparring preparation.

For training process management to be effective, the management system must possess scientifically grounded models of the object being managed in its current state. In the Poomsae context, such a model must account not only for athletes' physical conditioning but also neuromuscular control of movement precision, capacity for sustained attention concentration, and technical action stability under psychological competition stress. Therefore, the most pressing issue in Poomsae training process management remains rational planning of loads directed toward technical mastery improvement accounting for competitive activity specifics.



Training process planning with clear goal formulation enables more precise combination of strategic and tactical preparation tasks, more effective control of athlete development processes. A mandatory condition for optimal training load planning is constant pedagogical control providing feedback in the preparation system: coaches receive objective information about the current state of the managed system, process this information, and produce grounded decisions about corrective influence possibilities.

Creating adequate systems for controlling athletes' physical and technical preparedness is impossible without accounting for features related to sports specialization specifics (Poomsae versus Kyorugi), qualification level, sex, and age of the studied contingent. Ignoring even some of these factors leads to substantial reduction in pedagogical control effectiveness and, consequently, the entire training process. The training process at the pre-competition preparation stage has special significance, as this stage is final in the annual training cycle and allows finalizing athletes' technical readiness for responsible competitions.

LITERATURE REVIEW

The problem of training process management in taekwondo Poomsae remains the subject of active scientific research, although significantly less covered in literature compared to Kyorugi. Analysis of contemporary scientific-methodological literature indicates the existence of two fundamentally different approaches to constructing pre-competition preparation in formal exercises.

The first approach is based predominantly on general physical preparation, where the main emphasis is placed on developing strength, flexibility, and general endurance as a basic platform for executing complex technical elements. Representatives of this direction emphasize the importance of comprehensive physical development of athletes (Bompa & Buzzichelli, 2019). However, with this approach there exists an increased risk of negating Poomsae specifics, where more important is not maximum strength or general endurance, but precise control of muscular tension,



movement coordination, and ability to maintain technical stability throughout execution of the complete forms complex.

The second approach assumes that in training activity conditions, athletes should maximally utilize specific training means and methods that directly model competitive performances (Issurin, 2020). Here, the most important criterion for pre-competition mesocycle construction quality is the dynamics of technical mastery level and forms execution stability in conditions maximally approximating competitive ones.

Contemporary research in Poomsae preparation emphasizes the importance of psychomotor coordination and biomechanical aspects of technical element execution. Kim and Lee (2020) in their study of highly qualified Korean taekwondo athletes showed that individualized periodization of training loads accounting for athletes' personal biomechanical characteristics allows improving judging scores for forms execution by 10-15% compared to traditional approaches. Similar conclusions were obtained by Chen et al. (2021), who investigated the influence of static balance development level on quality of executing complex jumping elements in formal patterns.

Special attention in scientific literature is devoted to the problem of body weight control in combat sports. Reale et al. (2017) in their systematic review showed that rapid weight reduction exceeding 5% of body mass negatively affects not only strength indicators but also athletes' coordination abilities and cognitive functions. For Poomsae this is an especially critical factor, as loss of dynamic balance through organism dehydration can lead to technical errors in complex stances and jumping elements, directly reducing judging scores.

Regarding pedagogical control methods, Moreira et al. (2022) emphasize the importance of a comprehensive approach to monitoring combat athletes' preparedness, including both objective physiological indicators and subjective assessment of athletes' readiness. Santos et al. (2021) proposed an integrated control system for Brazilian taekwondo athletes combining biomechanical analysis, psychological testing, and



functional diagnostics. World Taekwondo (2025) in official Poomsae competition rules establishes clear evaluation criteria: accuracy of execution, presentation, and energy of performance. This requires coaches to implement objective control methods allowing quantitative assessment of athletes' preparedness level for each of these criteria.

Research by Bridge et al. (2021) demonstrated the effectiveness of using video analysis technologies for assessing technical mastery in taekwondo. The authors established that systematic video analysis with feedback provision to athletes improves technical element execution quality by 12-18% during an 8-week preparation period.

IDENTIFICATION OF PREVIOUSLY UNRESOLVED PARTS OF THE GENERAL PROBLEM

Despite the presence of a significant number of studies on general problems of taekwondo preparation, a number of specific issues regarding the Poomsae discipline remain insufficiently studied and require additional scientific substantiation:

First, the specifics of organizing pre-competition preparation specifically in Poomsae are insufficiently studied. Most existing scientific research extrapolates data obtained from studying athlete preparation in Kyorugi, which does not account for fundamental differences in the nature of competitive activity energy provision, psychological demands, and technical mastery evaluation criteria between these two disciplines.

Second, clear scientifically grounded recommendations are absent regarding the optimal ratio of physical and technical preparation means in the structure of pre-competition stage microcycles that could ensure maximization of performance technical stability without overloading athletes' nervous systems.

Third, the influence of body weight reduction processes on balance and coordination indicators requires additional clarification regarding qualified taekwondo athletes specializing specifically in performing formal patterns, as existing literature



data are contradictory and often based on research of representatives of other sports specializations.

Fourth, a comprehensive pedagogical control system adapted to Poomsae specifics is absent, which would allow objective assessment of technical precision level, psychological stability, and functional readiness of athletes at different stages of pre-competition preparation.

These unresolved issues determine the relevance and necessity of conducting specialized research aimed at developing a scientifically grounded training process management system for taekwondo athletes in the Poomsae discipline at the critically important pre-competition preparation stage.

ARTICLE AIM FORMULATION (PROBLEM STATEMENT)

Research aim: to develop and scientifically substantiate a training load management system for highly qualified taekwondo athletes at the pre-competition preparation stage accounting for specific requirements of competitive activity in Poomsae format.

Research objectives:

1. To determine the most rational structure of the pre-competition mesocycle and its constituent microcycles for taekwondo athletes specializing in Poomsae.
2. To substantiate the main parameters of training load management (direction, magnitude, and intensity) and their optimal distribution during the pre-competition preparation period.
3. To develop and substantiate a comprehensive pedagogical control methodology at the pre-competition preparation stage of highly qualified taekwondo athletes in the Poomsae discipline.
4. To experimentally verify the effectiveness of the developed training load management system for taekwondo athletes at their pre-competition preparation stage through pedagogical experiment.

RESEARCH RESULTS



Research Methods

A complex of complementary research methods was employed to solve the stated objectives. Theoretical methods included analysis and generalization of scientific-methodological literature materials, systematization and classification of data on training process management in Poomsae. Empirical methods encompassed a complex of methods for diagnosing physical development, functional state, and athletes' preparedness level, pedagogical observations of the training process, pedagogical experiment verifying the developed methodology's effectiveness, judging assessment of forms execution according to official World Taekwondo criteria.

The pedagogical experiment involved 18 highly qualified athletes (candidate masters of sports and masters of sports) aged 17-21 years specializing in taekwondo (Poomsae). Additionally, to study the influence of weight reduction on preparedness indicators, an experimental study was conducted with 20 athletes of first and second rank in taekwondo (weight 54-84 kg).

The following test battery was used to assess athletes' state and preparedness: static balance test (stance holding time in seconds), flexibility test (forward trunk bend from sitting position), R.M. Baevsky stress index for cardiovascular system functional state assessment, tapping test for determining nervous processes speed, tremorometry for assessing limb stability, attention concentration test (reaction time to stimulus appearance), SAN test (well-being, activity, mood). For technical-tactical preparation assessment, visual expert evaluation of forms execution quantity and quality was used, expressed in points according to precision, presentation, and energy criteria.

Pre-competition Mesocycle Structure

Based on scientific-methodological literature analysis, consultations with leading specialists, and previous research results, the optimal structure of the pre-competition mesocycle for taekwondo athletes in the Poomsae discipline was determined. The mesocycle lasting 4 weeks (28 days) includes four sequential microcycles, each having specific direction and load volume.



The basic microcycle (first week, 7 days) is characterized by a load volume of 35% of total volume at the pre-competition stage. Predominant training work direction is general physical preparation (aerobic endurance, general strength) and basic technique of forms execution. Load intensity is moderate, allowing creation of a functional base for subsequent, more intensive microcycles.

The special technical microcycle (second week, 7 days) also has a load volume of 35% of total. Predominant work direction is intensive practice of complex technical elements of forms and development of special physical qualities (static balance, coordination, flexibility). Intensity is high with emphasis on technical action execution precision.

The modeling microcycle (third week, 7 days) is characterized by reduction of total load volume to 20%. During sessions, competitive performance conditions are actively modeled with complete forms execution. Intensity reaches competitive level, allowing athletes to adapt to specific psychological and physical requirements of upcoming competitions.

The introductory microcycle (fourth week, 7 days) has minimal load volume of 10% of total. Predominant training load direction is active recovery, technical form maintenance, and psychological tuning for competition. Intensity is low, ensuring optimal organism recovery before start.

Indicator	Pre- experiment (M±σ)	Post- experiment (M±σ)	p
Forms execution score (points)	8.4±0.9	9.1±0.7	<0.05
Balance test (sec)	45.0±5.2	52.5±4.8	<0.05
Stress index (units)	61.0±8.8	54.0±6.8	<0.05
Tapping test (touches)	45±4.2	48±3.9	<0.05



Tremorometry (touches)	36±4.8	39±4.1	<0.05
Attention concentration (ms)	1074±127	980±110	<0.05
Flexibility (cm)	12.5±2.1	13.8±1.9	<0.05

Table 1. Comparative characteristics of taekwondo athletes' preparedness indicators

Dynamics of Preparedness Indicators

After the four-week pre-competition preparation stage using the developed methodology, statistically significant improvement of all technical mastery and functional preparedness indicators was recorded in experimental group athletes (Table 1). Positive dynamics characterized all main indicators determining athletes' competition readiness in Poomsae.

The most substantial changes occurred in technical mastery indicators: average score for forms execution increased by 8.3% (from 8.4±0.9 to 9.1±0.7 points, $p<0.05$). Stance holding time improved by 16.7% (from 45.0±5.2 to 52.5±4.8 seconds, $p<0.05$), indicating significant improvement in static balance level. Baevsky stress index decreased by 11.5% (from 61.0±8.8 to 54.0±6.8 conventional units, $p<0.05$), demonstrating improvement in cardiovascular system adaptive capabilities and stress level reduction.

Nervous processes speed and coordination indicators also improved statistically significantly: tapping test result increased by 6.7% ($p<0.05$), tremorometry by 8.3% ($p<0.05$). Attention concentration time decreased by 8.8% ($p<0.05$), indicating improved athlete ability for rapid attention focusing during technical element execution. Flexibility indicator improved by 10.4% ($p<0.05$).

It was established that athlete weight reduction by 2.5-3 kg (3.5-4.1% of body mass) does not exert substantial negative influence on absolute strength indicators but significantly improves relative strength indicators (strength-to-weight ratio), which is important for executing jumping elements and dynamic jumps in forms. However,



further weight reduction by 4-5 kg or more (5.8-6.8% of body mass) leads to statistically significant deterioration of coordination, static balance, and technical precision of forms execution indicators.

CONCLUSIONS

The conducted research allows formulating the following main conclusions. Training load at the pre-competition preparation stage of taekwondo athletes in the Poomsae discipline should be characterized by emphasized direction toward developing technical mastery, static stability, and psychological concentration. Approximately 35-40% of all training means employed in pre-competition preparation should be executed in maximum attention concentration and precise muscular tension control regime.

The most optimal duration of the pre-competition mesocycle for taekwondo athletes in Poomsae preparation is 4 weeks and includes four sequential microcycles: basic (35% of total load volume), special technical (35%), modeling (20%), and introductory (10%). This structure ensures optimal combination of load and recovery, allows sequential technical mastery level increase, and ensures achievement of peak form by competition time.

For effective training process control at the pre-competition preparation stage of taekwondo athletes in Poomsae, it is advisable to use the developed test battery including general physical working capacity assessment, functional state, special working capacity, and athletes' current state. A comprehensive approach to pedagogical control ensures timely detection of deviations from planned preparedness dynamics and possibility of operative training process correction.

It was experimentally proven that weight reduction of qualified Poomsae athletes by 2.5-3 kg (3.5-4.1% of body mass) is permissible and can even improve some relative strength indicators, while weight reduction by 4-5 kg or more leads to substantial deterioration of coordination abilities, static balance, and technical precision of forms execution, negatively affecting competitive results.



The effectiveness of the developed training load planning methodology is confirmed by pedagogical experiment results: after the four-week pre-competition preparation stage, experimental group athletes showed statistically significant improvement in all main technical mastery indicators (average 8-12%, $p < 0.05$), allowing recommendation of this methodology for implementation in practice of preparing qualified taekwondo athletes specializing in performing Poomsae formal patterns.

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